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Bell Telephone MAGAZINE

WINTER 1956-57

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The Sea Around Our Cables

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VOLUME XXXV NUMBER FOUR WINTER 1956-57

Bell Telephone Magazine

A non-technical review, published quarterly to give Bell System management people a broader view of the history, objectives, operations, and achievements of this business than they might attain in the course of their day-to-day occupations, and an added sense of participation in the problems and accomplishments of our nation-wide public service.

Cover: The Sea Around Our Cables.
Painted for This Magazine by *Albert Pucci*

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A MEDIUM OF SUGGESTION and A RECORD OF PROGRESS

JUDSON S. BRADLEY, *Editor* SALVATORE J. TAIBBI, *Art Editor*

Published for the Bell System by the Public Relations Department, American Telephone and Telegraph Company, 195 Broadway, New York 7, N. Y.

FREDERICK R. KAPPEL, *President* S. WHITNEY LANDON, *Secretary* JOHN J. SCANLON, *Treasurer*

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Who's Who & What's What In This Issue

FREDERICK R. KAPPEL was elected president of the American Telephone and Telegraph Company on September 19, 1956. He had been president of the Western Electric Company, the manufacturing unit of the Bell System, since January 1, 1954. Mr. Kappel started in the plant department of the Northwestern Bell Telephone Company in 1924. In the next few years he held many assignments in the plant, engineering, and commercial departments—all in Minneapolis. Ten years after he had joined the Bell System, he went to Omaha as plant engineer of the Nebraska-South Dakota Area, and three years later he was plant operations supervisor on the staff of Northwestern Bell at Omaha. In 1939 he became assistant vice president of operations, and after three years he was elected vice president of operations and a director of the Northwestern Bell Telephone Company. He came to A. T. & T. in January, 1949, as assistant vice president in the Department of Operation and Engineering. In February of that year Mr. Kappel was elected vice president of the Long Lines Department. In November, 1949, he returned to the General Departments as vice president in charge of Operation and Engineering. He remained in this post until he became president of Western Electric.

Virginius N. Vaughan, Jr.

Frederick R. Kappel

THE LONG LINES DEPARTMENT of the A. T. & T. Co. employed VIRGINIUS N.

John H. Page

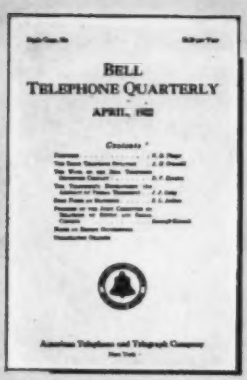
Vaughan Jr. in 1938, and in the next dozen years he worked on a wide variety of plant and engineering matters in almost as many places—in New Jersey, Virginia, Pennsylvania, New York, Washington, D. C. Then in 1950 he joined the telegraph engineering group in A. T. & T.'s Department of Operation and Engineering. The following year he transferred to the defense activities section, where he became service and protection engineer. In 1954 he was appointed teletypewriter and data systems engineer, and also chairman of the interdepartmental data committee. He returned to Long Lines last October, and was general methods engineer there until he was made a section head in the O. and E. Department as data and teletypewriter facilities engineer on January 1, 1957.

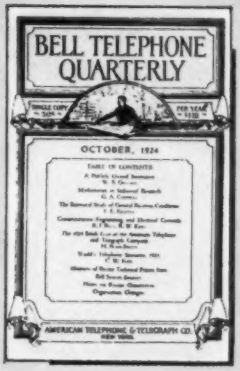
Joining the Ohio Bell Telephone Company after service in the Navy in World War II, John H. Page was a traffic assistant from 1946 to 1949. In the Public Relations Department thereafter he was successively editor of *Ohio Bell*, editorial manager, information manager, and executive assistant. In the Summer of 1955 he transferred to A. T. & T.'s Merchandising Department as staff assistant. That was his office when he conducted the merchandising seminars about which he writes in this issue. With the establishment of the Customer Products Planning Division in the O. and E. Department, it was logical for Mr. Page to become market studies supervisor in the new organization.

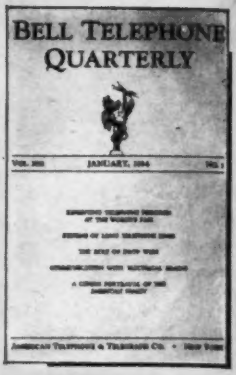
When Clarence H. Elder, of the Illinois Bell Telephone Company, and Philip J. Buch, of A. T. & T.'s Department of Operation and Engineering, discussed buried urban distribution systems, about three years ago, that first step led logically to the article which they have jointly contributed to the present issue of this Magazine.

(Continued on page 251)

Clarence H. Elder







THIRTY-FIVE YEARS OF PUBLICATION

A talk before the American Institute of Electrical Engineers in New York on January 21, 1957

THREE-DIMENSIONAL ENGINEERS

FREDERICK R. KAPPEL

President, AMERICAN TELEPHONE AND TELEGRAPH COMPANY

In his introductory remarks, Mr. Kappel referred to three points he wished to discuss, and continued:

IN THE FIRST PLACE, I have the greatest possible admiration for what our engineers have done to help make life better for more and more people.

Secondly, these changing times ask more *of* engineers and need more *from* engineers. Of this I have no doubt at all.

Thirdly, what are we going to do about it? How are we changing to meet the need? I'd like to expose my notions on that.

On the first point, just in this last generation—in the last 25 or 30 years—engineers have helped this country to improve its standard of living in a way that has never happened before anywhere. This notwithstanding World War II, Korea, and all the burden of defense we bear today.

Probably there's no single measure to express this. However, you can sum up a lot this way: Since the early 1920's, production per man-hour of work in private industry has just about doubled. Along with this, and because of it, while population and employment have both risen only about one-third since 1929, our gross national product has more than doubled. But the big pay-off is that the average disposable income of Americans—in constant dollars and after taxes—has gone up well over 50 per cent.

And in recent years something has come about in the United States that tells the same story in a different way. For the first time in history, the men and women of this country are devoting more hours to providing services than they now spend to produce goods.

We spend more time flying airplanes, hauling freight cars, distributing power, handling telephone calls, keeping store, lending money, taking care of the sick, making and showing movies, washing windshields, producing TV programs, teaching school, and performing thousands of other services, than we spend to grow food, make steel, produce oil, weave cloth, dig in mines, build houses, make automobiles, and turn out all the other products of manufacturing industry.

This in itself is a remarkable measure of what science and engineering have helped

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to bring about. Needless to say, the vast growth in service employment tells a story of millions of new jobs created. That's almost by definition. But my point is simply that we have come so far in enabling people to live beyond the limits of necessity. And I repeat—for the contribution you and other engineers have made to this, I have the greatest admiration.

However, that's enough about the past. The responsibilities now converging on the engineer are greater than ever before. As I've said, the times we live in ask more of us and need more from us.

You don't need to hear again from me about the race with Russia. That concerns me as much as it does you, but there are plenty of other things to be working at right on our own front porch.

For instance, take the way our population is increasing. We're growing at the rate of nearly three million people a year. Most important, however, we shall have a continually rising proportion of older people who have finished their working years, and also, for the next decade, a larger proportion of young people below working age. This means that a relatively smaller working group will have to support a much bigger nation.

If we expect to do this in the style to which Americans have become accustomed —and also, I hope, push the standard of living higher—we have a real job on our hands. And if on top of this, or along with it, we are to give economic aid and comfort to other parts of the world to keep them with us and not against us—well, let's face it: the job is gigantic.

The fact is that technological progress is not something that we can just look forward to with pleasant anticipation. It's a necessity. We *have* to have it because we shall have to produce more, and as I said, there will be relatively fewer people of working age. We can't just dream about shorter and shorter and shorter hours. We need to work and work hard, and we also need more and better tools, more mechanization, more plant and equipment that will do more work for us. And it's already coming home to us what this means in increased capital investment.

In the Bell System alone we expect to invest two and a half billion dollars this year in new telephones, cables, radio relay systems, central offices, and other equipment. For all industry, estimates vary, but I saw one forecast the other day that industry would lay out $40 billion for new plant and equipment in 1957, and that the annual outlay would pass $55 billion by 1965.

And who will see to it that all this money is wisely spent? To a very considerable extent, it must be the engineer. He is the architect of industry who must make sure that this huge investment will really produce—meaning, of course, produce at a profit.

And as he works at the job, the technical resources he is working with, and also the needs of people, are constantly changing.

On the technical side, take the changes in telephone transmission as just one example. It began on open wire lines, then went on to transmission over pairs of wire in cables. Cable carrier systems began about 1938, and soon afterward came coaxial cables.

Next came microwave radio systems and later, over-the-horizon radio. To build them, the engineer now has available klystrons, traveling-wave tubes, magnetrons, silicon diodes, coaxial lines and wave guides, resonators and filters and antennas.

Meanwhile, other carrier systems continue to multiply. One of the latest,

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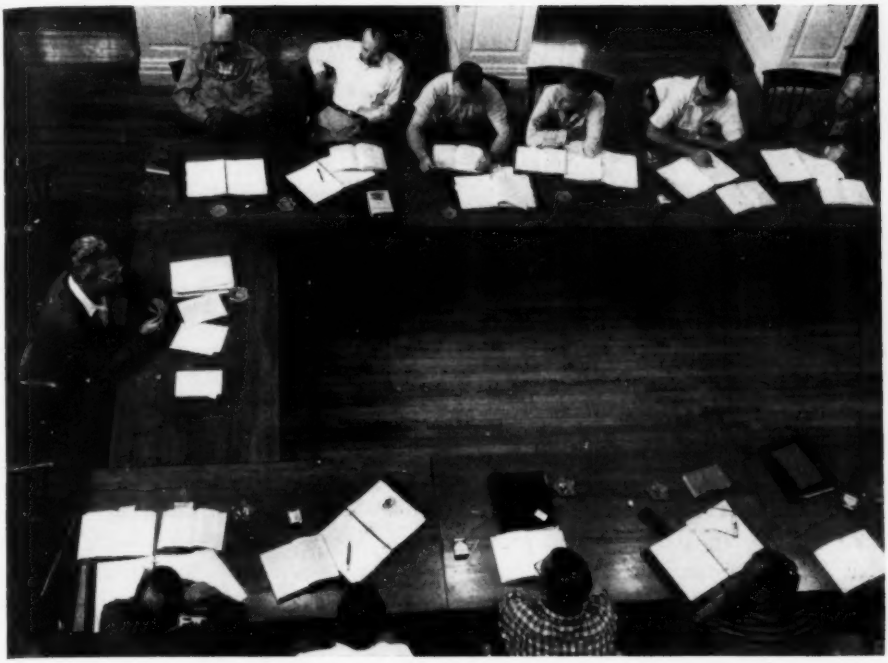


"In general, I would say we were in the early stages of extending engineering education..."

designed for rural telephone lines, uses transistors and has been tested successfully with a solar battery supplying power.

This year we expect to try out a new pulse transmission carrier system with repeaters using transistors and other miniature apparatus.

In my own engineering experience I've seen the maximum facility for telephone transmission change from three channels over a four-wire phantom group to a 14,000-circuit microwave system that is now under development, with the possibility of a 400,000-channel wave guide system coming along in the future.

And as systems multiply, and we learn new arts and new applications, components keep multiplying also. By the end of this year, for example, we expect to have more vacuum tubes working at the bottom of the sea than we had in the whole Bell System in 1920. In 1930 about 85 different kinds of vacuum tubes were available. Now there are more than 1400. The transistor was invented by Doctors Brattain, Shockley, and Bardeen, of Bell Laboratories, in 1948. Today more than 180 varieties are commercially available.

I'VE GIVEN just a few illustrations of rapid change in one field that I happen to be familiar with. We all know the same thing is going on in every field of engineering. Science is opening up new ways to live, new ways to work, new ways to travel on wheels or fly in the air. We're learning new ways to communicate, compute, control, and produce. We have new sources of power still in their infancy, and a great need to cause them to grow. We organize

new systems out of new devices, and new devices out of new materials, and we deal with the sub-atomic particles of elements which formerly did not even exist, at least to our knowledge.

Anyone who has any doubt about the pace of engineering progress could remove it pretty quickly, I think, just by glancing through the technical program for this meeting. To mention only one example, who would have foretold a few years ago that this program in 1957 would include papers on earth satellite communications and earth satellite telemetering?

THIS BRINGS ME to the main point I want to make, which is that in this dynamic and expanding world the competent engineer has to lead a dynamic and expanding life. In my judgment there is simply no room left for any routine approaches to engineering, or for standing still with the mental equipment we've got. The engineer has to grow and change with the times, and constantly equip himself to handle new problems. He has to nourish his mind and broaden his outlook to make sure that neither gets obsolete. And at all times, he has to look ahead.

Obviously we need the most in creative imagination, ability to take on new assignments, and selective judgment. I think the growing tendency in the schools to concentrate on fundamentals is very helpful to this, because the first need is to develop the basic mental equipment. There remains to industry the great responsibility to provide not only first-rate technical training but also to make sure the able engineer never gets locked in his technical closet.

To be sure, he always remains an engineer, with a sound grasp of engineering fundamentals that never grow obsolete. But he also becomes something more. As he applies ever-changing arts he is also thoughtful of their effects. He gains and uses knowledge of marketing and finance. He interprets between designer and salesman. He perceives and understands the general wants and particular problems of other people, whether he holds a supervisory position or not.

For such engineers I am quite sure the rewards will be ample—and I mean in money as well as in the sense of accomplishment. And, as I indicated, for people of ability, who have a real proprietary interest in the business they're engaged in, and want to make their interest effective in action, industry must certainly provide full opportunity for education and growth.

TO ILLUSTRATE what I mean, let me give you just a thumbnail outline of some of the educational activities we're organizing in Western Electric, Bell Telephone Laboratories, and the operating telephone companies.

The Communications Development Training Program at the Laboratories, or C.D.T. for short, is well known. It began in 1948 in response to the need to prepare graduate engineers for research and development work. The program extends over three years with about half the time in classroom work. More than a hundred men enter C.D.T. each year.

Starting in 1956 a small number of C.D.T. students are being awarded fellowships to allow them to study for their doctorates. While doing this they continue as employees at full salary.

About 140 professional members of the Laboratories are doing graduate work at nearby universities during part of their working hours, with tuition refunded by the Laboratories. For technical aides and also for engineers, the Laboratories also

conduct numerous out-of-hour courses. Participation is voluntary, and we expect some 1,500 registrations this year. In addition, a monthly lecture program has an average attendance of about 700.

The operating companies of the System are also moving to broaden their training.

Several of the companies have organized specific courses for engineers of from one to twelve weeks. One course, for instance, relates engineering to the over-all activity of the company. Another is on transmission. Others cover tariffs and rates, technical writing, the work of other engineering groups in the company, reasons behind the operations of other branches of the business, and so on.

Last September about 50 graduate engineers of the operating companies began 22 months of class work and study at Bell Laboratories to get a basic understanding of new telephone art, including electronic switching. We are just at the beginning of a gradual transformation of the Bell System's physical plant. In each company we shall have to have engineers who will take leadership in effecting this physical transformation, and also in training other engineers. This is the first step in a continuing program to that end.

In general I would say we were in the early stages of extending engineering education in the operating telephone companies. Much more is being organized right now, and the program that is taking shape in Western Electric may also be considered typical of efforts in the operating companies as well.

BY LATE SUMMER Western Electric will have three study centers, in New York, Chicago, and Winston-Salem. Here both new and experienced engineering employees will be enrolled. New engineers,

"...we shall be going a long, long way in the transformation of our physical telephone system."

"We're learning new ways to communicate, compute, control, and produce."

"We want engineers and other management people to think out problems together."

after their first four to six months with the company, will take a series of introductory courses to help them move into a full assignment. After a year's service they will have ten weeks more of study and discussion, not only on technical subjects but also in dealing with people. For experienced engineers there will be a wide variety of advanced courses. In addition, Western Electric now operates a plan to encourage employees to study on their own time at accredited colleges. The company will refund up to $250 a year tuition to any employee, part on enrollment and the rest on successful completion of courses which the company feels are related to the employee's present job, or to a job he might reasonably aspire to hold.

Throughout the Bell System, engineers are also participating fully in management development programs. We want engineers and other management people to think out problems together.

When we started our executive conference at Asbury Park two and a half years ago, we had several ideas in mind. We

wanted to bring telephone management people and top-flight men in other fields together for discussion and case study, and let the sparks fly. We wanted the least teaching in the sense of prescribing, and the most learning through one's own thinking. We hoped, too, that the Asbury Park idea would spread all through the Bell System at different levels of management.

All these things are taking place. And we shall encourage them more, not less. Indeed, we must.

Over the next ten years we foresee that more than 80,000 Bell System people—engineers included—will be moving into new positions in management. In the same ten years we shall be going a long, long way in the transformation of our physical telephone system. New art and new applications will bring new convenience in service and new forms of service. In fact, we expect the time is coming when we'll be able to communicate anything you want in just about any way you want, and over any distance, long or short. With people changing, management changing, technology changing, and service changing, it is unthinkable not to use every means in our power to improve our competence and at the same time our understanding of the world around us and our place in it.

You'll forgive me, I hope, for talking so much about the Bell System. But I think our need for engineers of ability and imagination is typical. We all need them as grass needs rain. And I think we can make rain.

We won't do it by just tagging or labeling people as engineers. We won't do it by putting engineers into compartments and shutting them off from the rest of the ship. We won't do it by cramming size 42 men into size 36 jobs, or vice versa. We won't do it by setting so-called minimum standards and then sitting back and letting nature take its course.

We *will* do it, I believe, through intelligent and concerted effort to develop what I call three-dimensional engineers.

The first dimension, we'll say, is what you got in college, that showed you how to move in a straight line in your first particular field.

The second dimension is in continued training and self-study, that broadens a man—or a woman—and keeps him up-to-date with technological changes so he can solve problems in broad areas and new areas of engineering.

The third dimension is the height that comes from the mixing and mingling of engineering and management ideas, so that the engineer's understanding of the problems and requirements *of* the business makes him more effective *in* the business. This understanding comes not only from study but from shoulder-to-shoulder association and contact and interaction between engineering, operating, financial, and merchandising people. And we need this third dimension not here and there among engineers but everywhere—so they will have a volume effect on the business. If engineering is to be solid, it's got to have this volume.

As I've tried to indicate, I think industry can contribute much, especially to the second and third dimensions. Right now in our business, because of the effort we're making in these directions, we're getting a wonderful amount of fine engineering work done that otherwise could never have been done so soon or so well. More than that, with a wider appreciation by other people in management of the engineer's contribution, I'm confident we're getting a better team and a better over-all

job. And I am equally confident that our engineers are profiting in prestige, promotion, and salary rewards as a result.

As THE NEED for technology increases further—and it surely will—it seems to me inevitable that the need for engineers in management—including top management—will likewise continue to increase. I don't see how it can be otherwise. What this means is simply that engineers must grow, and of course it is they themselves who must do the growing. No one else can do it for them. The training and education I've been talking about are essential, all right, but what they add up to in the end is only the soil to grow in.

Knowing engineers as I do—and I've lived and worked with them all my life—I can only say there is no group I would sooner trust to respond to whatever challenge. As I see it, the challenge to engineers today is that they should deliberately work to fill out all the height, all the depth, and all the breadth they can reach. Along with this, industry is equally challenged to give able engineers full opportunity to live and work and think and create in all three dimensions. For this is the kind of engineering influence and leadership we need, and I have great faith we shall get it, to the further advantage of our country and the world.

"The engineer has got to grow and change with the times, and constantly equip himself to handle new problems."

I. D. P. presents to the communications industry the opportunity to provide the vital link uniting elements in an expanding field of business

DATA PROCESSING BRINGS NEW OCCASIONS TO SERVE

VIRGINIUS N. VAUGHAN, JR.

Data and Teletypewriter Facilities Engineer, DEPARTMENT OF OPERATION AND ENGINEERING, A. T. & T. CO.

A CUSTOMER steps up to an airlines ticket counter in downtown New York and asks for two seats on the Silver Arrow flight to San Francisco leaving at noon next Friday. From a file before her, the agent selects a small card or metal plate which by special punchings identifies it with the Silver Arrow flight to San Francisco. She inserts this plate in the slot of an agent set – a small, neat apparatus on the counter before her, reminiscent of a miniature adding machine. She then pushes buttons corresponding to two passengers, the date, and the desired flight, and pauses to await a reply.

The waiting is only a few seconds while an electronic memory device, located many miles away, is checking its records. The answer, from the electronic record file of seats available, is almost immediately indicated by small lights on the agent's set. "I am sorry," she tells the customer, "we are sold out on the Silver Arrow, but I do have space on a one-stop flight leaving at 1 P.M. and arriving San Francisco at 8:30 P.M."

The customer says he will take the 1 P.M. flight, and the agent pushes buttons on her set to indicate that she is booking two seats on Flight No. 777, New York to San Francisco, on the 10th. In a few seconds, the electronic memory adjusts its records to show that the number of seats now available on this flight has just been reduced by two, and lights a lamp on the agent's set to confirm that the transaction has been recorded. Aside from the conversation time with the customer, the whole transaction has taken less than five seconds.

Fantastic? No. Not only is this practical, but it is already being done very satisfactorily on a small scale today. This is only one example of an automatic electronic data processing (E.D.P.) system—a development which is due to expand rapidly in the next decade.

TELEREGISTER CORP. EQUIPMENT

An airline agent set. Removable card, assorted buttons, and electronic mechanism, in association with a central computer, provide in seconds all the information needed to engage, record, and confirm reservations for a transcontinental flight.

Reservations – Before E.D.P.

DATA PROCESSING concerns itself with many different kinds of information. But if we confine ourselves, for the moment, to "reservations"—train, plane, and the like—and see how this operation was handled before the age of E.D.P., this will help to clarify the telephone companies' role in the data field.

Without E.D.P., the agent at the ticket counter would have picked up a telephone and talked to some one at the central reservations bureau. Or, if there were many miles between the two, she might have sent a teletypewriter message. At the reservation bureau, another girl would have taken the request for space and consulted her hand-written file record. Having determined that space was not available on the Silver Arrow, she would have told the agent so over the telephone or would have sent her a teletypewriter message. Then, after further exchange of information on the same basis, when the customer and the agent finally reached agreement on Flight No. 777, the reservations bureau would be told of the sale and the records clerk there would use a pencil to adjust her records to indicate two seats sold on this flight. The data processing equipment consisted of pencils, erasers, files, and human brains.

The telephone companies' part in both the old and the new system is fundamentally the same. Briefly, it is to provide the point-to-point communications between the agent and the centralized inventory file. With the old method, we did not provide the books in which the centralized inventory record was kept. With the new method, similarly, we do not provide the

centralized record file – an electronic memory device. This is provided to the customer by one of the business machine (computer – data processing) manufacturers. The great difference is the immensely improved speed and better service available with the new method.

Interrogation Data Systems

THIS RESERVATIONS EXAMPLE is typical of a large group of data processing applications which engineers refer to as "Interrogation" systems. They are usually characterized by a large number of outlying stations which wish to interrogate – question – a central memory and receive an immediate answer.

Another characteristic of interrogation systems is that usually the amount of data involved in an individual transaction is relatively small. For example, in the case of reserving a seat on a plane, the total number of characters needed to define a request is only 10 to 15, and the answer is even shorter. Therefore, "high-speed" transmission is generally not required; even at teletypewriter speeds of 100 words per minute or less, not more than five seconds are required for a complete transaction.

Other examples of interrogation data systems include credit checking, inventory, market prices, and the like. In practically all such instances, it is the communication companies' job to provide a direct communications connection between the device which accepts the data to be transmitted (usually a keyboard of some type and generally called a data input device) and the centralized electronic record file (usually a computer). In some cases we may also provide switching arrangements to select and connect together a specific input and the computer. This is because our telephone switching techniques and equipments are easily adapted for setting up the connections for data transmission, just as they are for setting up connections for a telephone call.

A large switching installation which serves a data processing center. In this instance the telephone company provides switching arrangements to permit transmission of data from any of a number of specific input devices to a computer or other data machine.

I.D.P. – Integrated Data Processing

THE INTERROGATION SYSTEM is only one of many facets of "data processing"– a term which, along with "I.D.P.", has recently been much in the news. There are good reasons why these terms have caught the public fancy. The applications of I.D.P. are growing rapidly, and great potentialities exist with some of the newer and more complex computing machines. As is so often the case when we make rapid growth and progress, we have two new items: a new concept and some new equipment. The new concept is I.D.P., and the new equipment is, primarily, the electronic computer, which is based on a vast amount of work–with magnetic cores, transistors, etc. – on the development of such devices.

In order to get a better general understanding of the whole subject of I.D.P., let us begin with the familiar. The adding machine is a data processor. The cash register and the desk calculator are data processing machines. At the other end of the scale of complexity, there is the giant computer (popularly called an "electronic brain") such as is installed in the Bureau of Standards to perform all kinds of difficult scientific calculations. Other data processors include the complicated mechanisms which control the complex switching arrangements used in operator dialing and DDD (Direct Distance Dialing) of the telephone industry. All of these:

(1) accept input information–from a keyboard, from a telephone dial, a series of pulses, etc.;

(2) process this information – add, subtract, multiply, divide, compare with other stored information, etc.; and

(3) take action – print out a result, establish a connection, etc.

Thus, data processing is not new to the businessman, the engineer, and the scientist. But the "integrated" aspect of I.D.P., while not completely new–even in our generation–is an important addition to the whole concept of data processing. The I.D.P. concept is particularly applicable to business systems where data originate from a variety of sources and where the data processing must keep up with the whole operation of the business.

Integrating the Various Processes

HENCE it is mainly as applied in the field of business and industry that we hear the term I.D.P. What it means is that the various individual data processing activities (whether they be mechanical, electronic, or manual) which go on as separate and often geographically scattered operations are integrated into a coördinated whole by linking them together. The fact that these operations are to be tied together has an important effect on the operations themselves, for they must be made compatible with each other so that they can work together. Compatibility means, among other things, that the data which are the result of each individual operation must be expressed in the same "machine-sensible language"; that is, they must be recorded in a particular manner so that other machines can "read" the data and be able to process and act on them. By machine-sensible language we mean codes which convey information to the machines in much the same way that ordinary language conveys information to people. This language is often recorded on punched paper tape, or punched cards, or magnetic tape (with magnetized spots corresponding to the holes in punched paper tape).

The integration of data systems is the aspect that brings the communication industry into the picture.

Let us consider a simple example of I.D.P. – different from the reservation example, but typical of many business and industrial operations today.

The various tools of data processing, whether manual, mechanical, or electronic, must be made compatible with one another, so they can work together

I.D.P. Applied to Order Handling

A STEEL COMPANY's branch office in Chicago receives an urgent order for special steel plate which must be procured from a plant near Pittsburgh. This is only one of many such orders which this office handles every day, but let us follow the progress of this order.

A typist in the branch office prepares the order, using either a special typewriter –one equipped with a tape punch adjunct –or a teletypewriter. As she types, her machine prepares a page copy and at the same time it prepares a (by-product) punched paper tape, and thus there are two outputs for a single keyboard input. When she has finished typing the order, the punched tape contains, in "machine-sensible" language, all of the information about this order. The identical information also appears in "human-sensible" language on the page copy.

In many instances—illustrating a fundamental of I.D.P.—these special typewriters or teletypewriters employed in originating orders are so arranged that it is not necessary for the operator to use her keyboard to enter the name, address, shipping instructions and other "fixed" information about regular customers. Instead, she draws from her master file either a punched card or a short piece of punched tape and inserts this in her machine. The master card (or tape) contains all of the fixed information regarding this particular customer; reading it, the machine operates

just as though the operator were manually entering this information with her keyboard.

When the preparation of the order has been completed, the page copy is checked for accuracy. This one operation also serves to check the tape for accuracy, because it correlates character-for-character with the page copy. The by-product tape is then inserted in a tape transmitter which "reads" the tape and transmits electrical pulses corresponding to the number and configuration of the holes punched in the tape. This "sensing" or "reading" of the tape is done, character by character, as the tape is stepped through the transmitter, and the order is sent over a teletypewriter circuit to the steel company's headquarters in Pittsburgh. As the tape is being "read" in Chicago, the order is being received in Pittsburgh in two forms: as a page copy and as a punched paper tape – both exactly like the ones prepared in Chicago. Although the transmission from Chicago to Pittsburgh was (in this example) on a paper tape-to-tape basis, it might have been on a punched card-to-card basis, or on a magnetic tape-to-tape basis. In any event, the result would be the same.

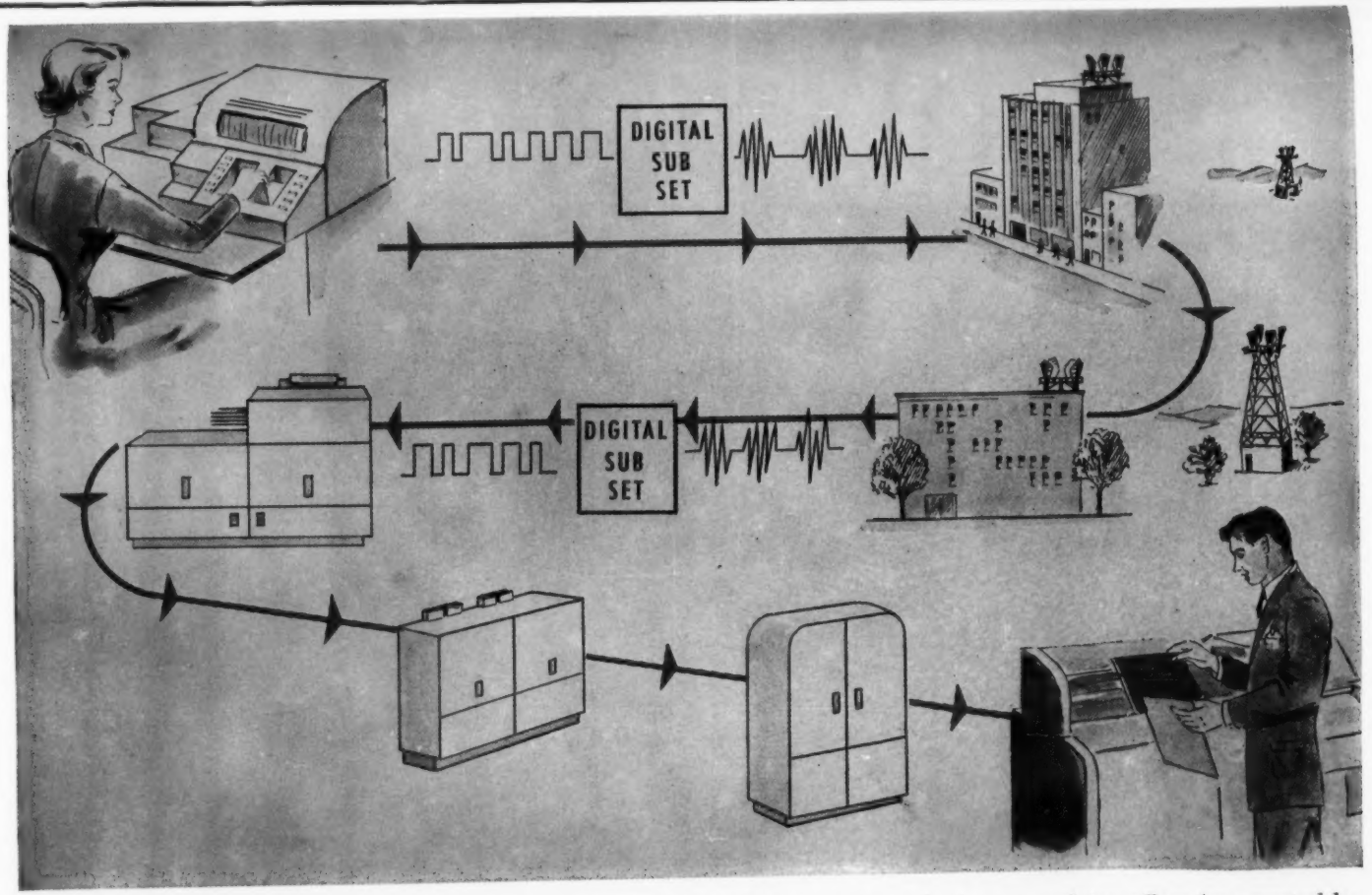
At Pittsburgh, the paper tape (or punch card) now goes—along with other tapes or cards corresponding with other orders—to a customer-provided computer. This computer can be any of many types and can be made to do many things. For example, it can compute costs, it can check whether the particular items are in stock and determine where they are located, it can suitably adjust the inventory, and it can produce all this information either (or both) as typed copy or in "machine-sensible" language on tapes or cards. These tapes or cards can then be transmitted to the shipping department, the billing office, the manufacturing department, and anywhere else the information is needed. Ultimately, the information is converted to "human-sensible" language so that people can ship the steel plates, takes steps to replenish stock, and do other things which are necessary.

The net result of all this is greatly improved accuracy plus a large saving of time and effort. Instructions and information are available to everybody who needs them, and the whole data handling and processing are completed only a few minutes or a few hours after the order was originally placed.

Bulk Data

THE ORIGINATING and transmitting of the steel order from the Chicago branch office, together with the processing of the order in the Pittsburgh home office, is an example of a "bulk" data system—so named to distinguish it from the "interrogation" type cited at the beginning. Other examples involve bank statements, payroll reports, production reports, many types of purchase orders, train "consists," scientific test results, payments received, and similar kinds of data. One characteristic of such systems is that they do not require immediate transmission and answer, as is the case with "interrogation" systems. In the case of business data systems, transmission may take a few minutes or even hours.

Another characteristic of bulk data systems is that, as the name implies, they generally involve large volumes of information. Hence in many instances the high volume alone may justify the use of a "high-speed" circuit, simply to be able to move the required volume of data within a reasonable period. The term "high-speed" does not mean that the miles-per-second at which signals travel (once they are on the circuit) is any faster than on a "low-



This diagram illustrates how communications provide the vital link which connects each of many outlying offices (represented by the girl at the upper left) with complex data processing equipment at the home office. The digital subset adapts the communications channel to data transmission.

IBM EQUIPMENT IN THE BACKGROUND

A teletypewriter operator (right) prepares a page copy of her message, and coincidentally, a machine-sensible punched paper tape. The same information appears simultaneously, in both forms, at the destination (above), where it is processed for further transmission.

speed" circuit. Rather, it means that the high-speed circuit can accept and deliver data faster—somewhat like having a bigger pipe to carry water.

As business and industry grow, as the use of I.D.P. grows with them, and as decentralization is extended, the need grows for higher data transmission speeds. So our Bell Telephone Laboratories are busy developing arrangements to handle higher and higher speeds to keep pace with our customers' ever-expanding volumes of data requiring transmission. Error detection and correction methods and many other subjects related to data transmission are also under study in the Laboratories.

What I.D.P. Can Do

"THE DIFFICULT we do now, the impossible takes a little longer" is a familiar saying. And so it is a little dangerous to try to generalize on what we can do or cannot do with data systems. But perhaps some generalization along this line may serve to clarify the broad picture.

One of the most obvious things that I.D.P. can do, as in the foregoing examples, is to save time and effort and to improve accuracy. But many systems do much more than this. They can do things which, for practical purposes, cannot be done by manual means—or cannot be done in time to be of any value.

Let us consider some of the more spectacular things where extremely high speed for carrying out analysis of data and complex computations are of utmost importance. Quite naturally, the military requirements are one of the best examples in this field. Here there are situations where the data are just too numerous and complex, and the processes necessary to digest them are too complicated, for humans to be able to act in the time available. The whole complex of national defense, particularly against possible attacks by air, is in this category. Here machines must do the sorting, adding, subtracting, multiplying and dividing, the cross-checking, and the many other things that need to be done so that the people who make decisions will have the right information, in the right form, at the right time. The various units of equipment which make up this complex may be many miles apart, so that the whole operation is an example of I.D.P. in one of its most complicated forms.

In business and industry, where the movement and processing of data can be somewhat more leisurely than in the military, I.D.P. can do things that would, for practical purposes, be impossible without it. For example, a centralized computer can keep up-to-date (or up-to-minute, if necessary) records of sales, inventory, production, financial operations, and any other information which management needs to run the business effectively. By the use of communications channels, these records can encompass all of the operations, even though some may be thousands of miles away. Thus while I.D.P. may or may not produce cost savings, it can produce results through which management can better control the business and through which the firm's customers can get faster and more reliable service.

Some forecasters have predicted that I.D.P. will do for paper work in business and industry what automation and the production line have done for manufacturing. If this be true, we should be able, on the whole, to do more things and do them better and cheaper. This is certainly the American way of life.

What Machines Can't Do

MACHINES are not an end unto themselves; there are many things that people will have to continue to do. Machines have no intelligence – in the usual sense of the word. They will do those things which they have been told how to do – tirelessly and very fast; but they will do *only* those things. If a machine encounters a situation which it has not been told specifically how to meet, it is unable to proceed.

So one of the big jobs which people have to perform is to instruct the machines precisely what to do under any given set of circumstances and how to do it. In any data processing system which must handle a variety of complex situations, this work, called "programming," is a task of major proportions. It is likely to be a continuing

task because the instructions to be given to the machine must be changed every time business operations or circumstances change.

Furthermore, people will have to continue to supply those human qualities which are necessary to coördinate the data produced by the machines with the numerous other things—many of them intangible and requiring judgment – that enter into making sound decisions.

So, people will continue to run the machines and not vice versa.

How We Transmit Data

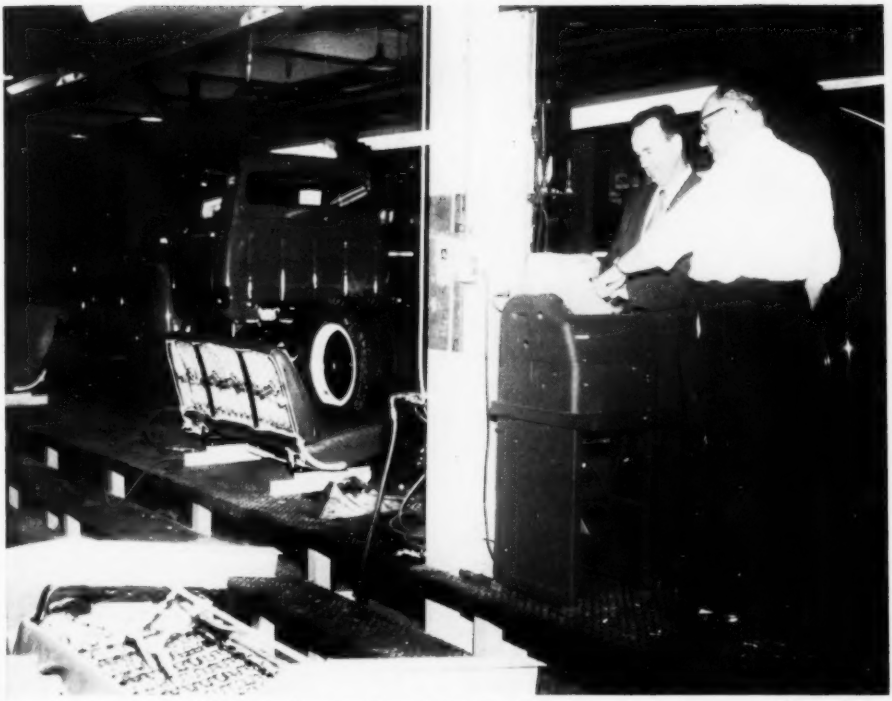
No ARTICLE on Data Systems would be complete without some description of just how we transmit data. However, this is a major subject within itself and involves considerable complexity. Nevertheless, a simplified explanation is in order.

To begin, data are usually (but not always) expressed in a "binary" code. This is not as complicated as the word may sound to unfamiliar ears. It is something like wig-wag signaling with a flag. Each letter or numeral is expressed as a particular combination of "yes" bits and "no" bits. A bit is the smallest possible increment of information—either a "yes" or "no". Some textbooks define "bit" as a contraction of the words *b*inary dig*it*. But most engineers who have grown up with the new vocabulary of digital data are inclined to scoff at so formal a definition and say that, unless we want to get complex and talk about "conditional bits" and so on, we can simply say that a "bit" is a "yes" or a "no".

Hence, as with our teletypewriter punched tape, for example, we can devise a code in which each letter of the alphabet is represented by a certain combination of

REMINGTON RAND EQUIPMENT

A typical large computer center. Control board is in foreground, peripheral input and output equipment is at right, and in back is the electronic computer equipment.



An automotive production line and an I. D. P. teletypewriter system, working hand in hand, play their part in the modern American industrial process

"yes" and "no" bits. Numerals, symbols, and instructions to the data processing machines may be similarly represented. The "yes" bits correspond to the holes in punched paper tape, the "no" bits to no holes. The same applies to punched cards. Spots of magnetization (or no magnetization) are similarly used on magnetic tape. These are fundamentals of our "machine-sensible" languages.

Therefore, data transmission requires the conveyance of specific combinations of "yes" and "no" bits. If the data are recorded on punched paper tape, for example (or cards, or magnetic tape), this tape may be placed in a "reader" which will sense each bit and present it as a "yes" or "no" to the digital terminal of the communications channel. In this terminal, the "yes" or "no" is used to modulate a carrier frequency tone—generally a frequency which can be transmitted over practically any of our many types of voice-frequency channels. At the receiving end, the tone is demodulated and a replica of the original "yes" and "no" bits is fed to a tape punch, or card punch, or magnetic tape recorder.

In some instances, data transmission is machine-to-machine, instead of tape-to-tape as in the foregoing. However, this is not fundamentally any different, from the standpoint of communications, because the machines can be arranged to deliver the bits directly to the communications channel terminal at the sending end and to accept them directly from the communications channel terminal at the receiving end.

The communication channels used for

data transmission are generally the same type as are used in providing telephone and teletypewriter services. Teletypewriter facilities are now widely used for data transmission. The basic voice frequency channel is expected increasingly to become our "workhorse" for data transmission; some of the new developments which are now under way will further exploit the possibilities which these channels afford.

Channels are available having a variety of band widths extending from the slow-speed signaling channels up to the wide-band (high-speed—high bits per second) video channels which are used for color television. This is not to overlook the fact that special terminal equipments are required to adapt the channels to data transmission—just as a telephone subset must be used to adapt them to voice transmission. Therefore, keeping pace with new requirements, the Bell Laboratories are developing new and improved terminal devices for use with data transmission.

The Future

MANY OF THE computer manufacturers have said that the future growth of their business is, to a substantial degree, dependent on the communication companies: dependent on linking together all of the locations between which data must flow. The computer makers and other business machine manufacturers are unanimous in their predictions of a tremendously expanding business. This is evidenced by the fact that the older companies are being joined by so many newcomers to the field. The telephone companies are working jointly with these people, planning for the future to be sure we are ready to provide any and all communications that will be needed.

Today, we have made a good start, and many good data systems are in operation, using our private-line telephone and teletypewriter facilities. The progress of tomorrow will certainly bring new requirements which do not exist today. Communications people are accustomed to meeting changing and growing demands. This is a normal part of our job and we expect to meet the data transmission needs of all our customers.

All aspects of American life have undergone great change, and this places a heavy premium on the whole merchandising process

MERCHANDISING SEMINARS: LEARNING FROM OTHERS

JOHN H. PAGE

Supervisor of Market Studies, CUSTOMER PRODUCTS PLANNING DIVISION, DEPARTMENT OF OPERATION AND ENGINEERING, A. T. & T. CO.

SINCE THE SPRING OF 1956 three groups, each of forty department heads and officers of Bell System companies—including A. T. & T.—have taken part in merchandising seminars to discuss the promotional problems of the U. S. Plywood Company, the distribution problem of The Pocket Books Company, the pricing problem of The Morton Company, and the daring move of The Gobelin Chocolate Company.

They have listened to presidents and chairmen of the board of large and small industrial companies. They have heard of the detailed product and market research behind the newest Gillette razor. They have heard General Electric executives describe how they coordinate product planning, market research, and production. They have heard a distinguished analyst give his account of why the railroads no longer earn or serve as they did forty years ago, and they have heard the president of the Institute of Life Insurance and a distinguished author and professor discuss the need of adapting one's service and policies to the tenor of the times.

This experience has had a profound effect on those telephone men involved. One top operating man perhaps summarized it best when he said at the end of a Seminar, "If someone had told me ten days ago that I would be thinking as I do now, I would not have believed him."

But before getting more deeply into the teachings of the seminars, perhaps one should answer the question of why this interest in the field of merchandising. Why these seminars at all?

Merchandising is a product of the times. So, of course, are the seminars. Let us take for a moment the long view of our business. Since its beginning, we have been striving to make the telephone a mass service: to implant a telephone in every business, in every home, and the habit of common daily use of the wide variety of our services. We have made real strides towards this goal—even though our progress has been interrupted by two wars and a great depression.

Most recently, World War II called a halt to normal progress. At its close, we were confronted with an enormous backed-up demand for our services, and in the last ten years we have undertaken prodigious expansion and building programs to try to meet this huge demand, with the thought that sooner or later we would again return to normal conditions, normal growth.

A Change in Kind

Unconsciously, perhaps, the normal we thought of was the 1941 normal. Today, as we are beginning to emerge from the post-war era of expansion to catch up with expressed demand, it is more and more apparent that we are not dealing with a 1941 normal. America has changed, and the change is so great it is almost one of *kind*, not just of *degree*.

This new America has been called "The Big Change" and "The New American Market." Whatever the name, its symbols have been Suburbia, outdoor living, appliances, and family vacations. Its economic underpinning is an increase in population and a very significant increase in the number of families who have what economists call discretionary buying power—money to spend over and above very basic needs. This buying power has two characteristics. It can be used today, tomorrow, next year, or never; and when used, it can be and is spent on a wide variety of goods or services. For all industry, these very characteristics put a heavy premium on the whole merchandising process. They have the same effect on us, especially as an increasing amount of our revenues is today coming from other than "necessity" services. We too are benefiting from this new spending power; and because it is postponable and redirectable, we find our-

Throughout the country, the demand for service has continued unabated.

The new America's economic underpinning is a significant increase in the number of families having discretionary buying power.

selves more and more in competition with a wide variety of other industries for the consumer's dollar.

This new America has already had a marked effect on our business. For instance, today 76 percent of the homes have telephones, while in 1941 only 39 percent had them; while in 1941 four-party service was preferred by many, today it is acceptable only to far fewer.

Thus we find Americans demanding a new standard of telephone service. What is it? And perhaps even more important, what will it be next year or in five or ten years? For certainly we must try to find out if we are to anticipate customers' needs and desires and thus be able to get ahead of them. As our original goal of a telephone in every home comes nearer, how and in what direction shall we grow? What will be the effect on us as more and more of our revenues come from other than basic or minimum-service charges? How can we profitably create new markets for our services or for new and more comprehensive services?

Genesis of the Seminars

THESE ARE the basic questions which brought about merchandising as a specific telephone activity and led to creation of the Merchandising Department, and from these came the merchandising seminars.

Specifically the seminars were designed to find out how other industries are molding themselves to this new market, to this new America. How do they create new markets? How do they anticipate customers' needs and desires? How do they profitably merchandise their goods and services?

With this objective in mind, the sem-

Seven days were devoted to just hard learning about all aspects of merchandising.

inars were organized as follows: Seven out of the twelve days were devoted to just plain hard learning about all aspects of merchandising—market research, product planning, marketing strategy, advertising and promotion, pricing, etc. Most of this came from selected reading and the study and discussion of marketing cases led by professors from the Graduate School of Business Administration of Harvard University.

Three days out of twelve were devoted to talks by speakers who, as men of experience or as expert observers, were able to give the conferees conviction and belief in the value and importance of the merchandising approach. In short, these men said, "This works in my business and I believe it may work in yours."

Two days were devoted at the end of the seminar to the application of the principles discussed to actual telephone situations. This was done by means of analysis and discussion of especially prepared telephone cases.

The seminars were held at the Garden City Hotel in Garden City, New York, in April, September, and October, and each was two weeks long.

What Went On

A TYPICAL DAY consisted of small group discussions of cases from 8:30 to 10:00 in the morning, followed by a group discussion of all the participants, moderated by one of the Harvard professors. After lunch, a similar schedule was followed, this session ending at 4:30 p.m. Then usually the conferees started studying the next day's case material until dinnertime and again after dinner until fairly late in the evening. The schedule was heavy, and it is testimony to the participants' interest that few went to bed early. On three days, cases gave way to speakers, one in the morning and one in the afternoon,

Three days were given over to speakers of experience in the importance of the merchandising approach.

with time for questions and discussion following each speaker.

The cases, which were a fundamental part of the program, deserve some comment; for a non-participant may find it hard to visualize them or to appreciate their value. At each seminar, 16 cases were used. These cases were selected from the many thousands developed by the Harvard Business School for its various courses of study. Each is a real business situation, and in many cases the actual company names are used. Each describes the factors known to management, and the situation as management saw it. The conferee's problem is to digest the factors, analyze them, and decide what he would do in the particular case, and why. The moderator, through discussion, draws out various possible approaches to the problem and the principles involved.

It has been said that the case method is a hard way to teach—that possibly it is easier and faster to acquire knowledge by lectures and reading. Maybe it is, and certainly the supplemental reading was a valuable part of the merchandising seminar; but the conferees were loud in their praise of the value of the case approach. "It requires hard mental effort," they said, "but after you struggle through a case for yourself and then participate in the discussion, you have really learned, and the principles you have learned stay with you."

To What End?

Now, JUST WHAT did the conferees learn? What did they get out of the conference? Obviously, there is no uniform or specific answer. But perhaps some generalizations picked up from the conferees will give a general picture. Many said: "I learned to have a questioning attitude"—a resolution not to accept first impressions or long-standing procedures but rather to question practices, prices, and services from the market point of view.

Case after case illustrated examples of where first impressions and the non-market approach resulted in unworkable or unprofitable decisions. In fact, although we learned many marketing principles which will be most helpful in approaching our own jobs, we learned too that no marketing problem can be reduced to a formula which will work every time. Judgment and intuitive sense are essentials for successful merchandising.

Others commented on the need to plan for the market—a conviction that in the ultimate it is the consumer who must control the design of a product or a service, its method of sale, and the promotion methods used. Many of the cases illustrated how failure to follow this very basic principle was disastrous. Too, many of the participants were struck with how much more extensively other businesses rely on market research, product research, and market testing than we do. Certainly the seminar opened our eyes to the ways that more emphasis on these functions could be helpful to us in the telephone business.

Perhaps, though, the fundamental lesson that most of the conferees felt they learned from the seminar was that the merchandising concept may well be as large a contributor to the Bell System's profits and its capacity to serve the public as are technical research or other elements. This conclusion resulted from two factors. One, the possible course of the System if it elects just to grow with demand—a course which inevitably points towards less individual initiative and an increasing degree of public regulation and control. The other, the possibilities for both profit and service if, through a merchandising approach, the system is ahead of demand and creates desires and wants. The weight of evidence both from the speakers and the cases was that the latter

A typical day consisted of small

approach is not only possible but very realistic.

The Outsider's Viewpoint

FROM ITS INCEPTION the seminar aimed to bring before the participants an outsider's point of view on merchandising, and this it certainly did. Speakers and moderators included five professors from business schools, four presidents of large companies, two economists, two women retail executives, two leading men in the field of marketing research, the chairmen of the boards of two large soap companies, an author and consultant, and a distinguished investment banker as listed on page 209.

These men were not asked to give their impression of our business, neither were they asked to give recommendations on how to improve our business. Rather, they were asked to tell us about their business or about some aspect of merchandising on which they were particularly qualified.

However, from the nature of their remarks, many received the impression that there were some factors to which they gave greater weight and importance than do we traditionally in the telephone business.

Profit was one of these. To them, every decision, be it related to production, engineering, sales, or promotion, was related directly to ultimate profit. Nearly all of the telephone participants, long trained in service standards and functional operating procedures, were struck by this profit-oriented thinking.

Likewise, it was apparent that outside companies use and place a heavy value on all types of consumer and product research. As one of the speakers put it, "Fact is always better than opinion, and findings in the field of customer preferences and wants are as important as technical research." In this regard, too, it is evident that to these speakers the consumer is completely dominant. In fact, some outside companies have had to reorganize to insure that customer desires

group discussions of actual cases.

In the ultimate it is the consumer who must control the design of a product or a service . . .

take precedence over engineering and administrative opinion or traditional policies.

Many, too, appeared to talk of risk. The impression was left that you must risk if you are to gain. Test, research, prove, and analyze as much as you can, they say, but when you are reasonably sure, take the risk, or, as one put it, "mortgage the farm."

Perhaps the reader can get a better feel of the impact of what these speakers had to say if I quote some of their thoughts. For instance, one speaker, talking of a service business having certain problems, such as ours, had this to say:

"It is clear that in the descent from the top of the economic ladder this business has been unwilling to face up to the realities of its problems. It is my opinion that concealing difficulties cannot be successful in any kind of regulated industry."

And this:

"At times some of these managements have seemed to believe that they are in the business of manufacturing statistics instead of making money by merchandising transportation and giving the customer what the customer wants."

Another said:

"Operations and merchandising operate too frequently in separate, almost airtight pockets. Such a form of organization can be the death of efficient, elastic 'on your toes' merchandising."

Still another, hazarding general comment about the telephone business, said:

"This means that you need new objectives and, above all, new habits and new visions. Otherwise the danger is great that you will become bureaucratic, and that you will become complacent. And in your kind of business, this means inevitably that sooner or later you will become nationalized either because of inability to earn what is needed in view of new and very much greater risk you face or because of inability to attract the capital you need for expansion."

These, then, are some specific impressions that this outside group brought to us. But the real value of the seminar is more intangible: it was a philosophy or a point of view. It is hard to describe, for it is many-sided. On the one hand, it says "Do not be proscribed in your thinking—there is no perfect, no only way to do a job." On the other hand, it says that

Speakers at merchandising seminars

Mrs. Sara Lynn Anderson, *Merchandising Vice President,* L. Bamberger & Company.

Melvin L. Anshen, *Professor of Industrial Administration,* Graduate School of Industrial Administration, Carnegie Institute of Technology.

Jervis J. Babb, *Chairman of the Board,* Lever Brothers Company.

Milton P. Brown, *Associate Professor of Business Administration,* Graduate School of Business Administration, Harvard University.

Edward C. Bursk, *Professor of Business Administration,* Graduate School of Business Administration, Harvard University.

Robert T. Davis, *Assistant Professor of Business Administration,* Graduate School of Business Administration, Harvard University.

Richard R. Deupree, *Chairman of the Board,* The Procter & Gamble Company.

Fairman R. Dick, *Special Partner,* Dick and Merle-Smith.

Peter F. Drucker, *Professor of Management,* Graduate School of Business, New York University.

Robert F. Elder, *President,* Plax Corporation.

T. V. Houser, *Chairman of the Board,* Sears, Roebuck & Co.

John E. Jeuck, *Professor of Business Administration,* Graduate School of Business Administration, Harvard University.

Holgar J. Johnson, *President,* Institute of Life Insurance.

Fred O. Kiel, *Senior Economist,* Federal Reserve Bank of Cleveland.

Dr. Marcus Nadler, *Professor of Finance,* Graduate School of Business Administration, New York University.

Robert S. Perry, *Vice President, Razor Division,* Gillette Safety Razor Company.

Mrs. Jean Wade Rindlaub, *Vice President,* Batten, Barton, Durstine & Osborne, Inc.

Elmo P. Roper, Jr., *Marketing Consultant*

Joseph P. Spang, Jr., *President,* Gillette Safety Razor Company.

"there are no immutable laws that govern a company's progress, its profits, or its growth, but rather that management can and does control a business's destiny; and inherent in the philosophy is the steady warning that the market, the customer, is all important." It says "know his desires, his needs, his moods, his tastes, even his aspirations; be ahead of them, and somehow provide the goods and services to satisfy them; for in the ultimate, the public will get what it wants. For if a business or an industry does not meet the public expectation, someone else will."

Perhaps it was this philosophy, based on the evidence of the speakers and cases, that was the most valuable result of the seminar. Many of the participants felt so. To them it is the merchandising concept, and its real value to the Bell System will be in direct proportion to how much it can be brought to bear on all aspects of the business.

The New Cable to Alaska

COMMUNICATION FACILITIES between Alaska and the United States were more than doubled when an underwater telephone cable system was opened on December 11, 1956, from Port Angeles, Wash., near Seattle, to Skagway. The undertaking, which greatly increases the reliability and security of conversation, involves two projects—one provided by the Long Lines Department and the other by the Alaska Communication System, which is operated by the U. S. Army Signal Corps.

The A. T. and T. Company undertaking is a twin cable system with built-in amplifiers (similar to the deep-sea portion of the recently inaugurated telephone cable under the Atlantic), extending 900 miles from Port Angeles to Ketchikan, Alaska. At this point a single submarine cable of the ACS stretches along the inland waterway on the southern coast of Alaska to Skagway. This cable utilizes amplifying stations situated on islands or points of land that dot the area. A radio relay link provided jointly by Long Lines and the Pacific Company connects the southern terminal of the cable system with the U. S. telephone network at Seattle. Beyond Skagway, the circuits are fed into the Alaska communications network operated by the ACS.

It took more than two years to build the new system, which can carry 36 conversations at one time and will be used to supplement the radiotelephone and land line facilities that have been operating between this country and Alaska since 1937. The inaugural call was made over a 4,600-mile telephone circuit that linked Washington to Juneau and included Seattle, Ketchikan, Anchorage and Fairbanks. At each location government, military and industrial officials participated in the ceremonies.

The newest submarine telephone cable is landed at Skagway, Alaska, from the cableship Albert J. Myer.

XUM

Recent developments in cable manufacture, plus experience with buried rural and intercity telephone cables, point to the establishment of urban buried cable systems

PUTTING CABLES UNDER GROUND IN URBAN AREAS

CLARENCE H. ELDER

Outside Plant Engineer, STATE AREA, ILLINOIS BELL TELEPHONE COMPANY

and

PHILIP J. BUCH

Cable Engineer, OUTSIDE PLANT SECTION, DEPARTMENT OF OPERATION AND ENGINEERING, A. T. & T. CO.

THE WIRE WHICH first transmitted the human voice was strung overhead between rooms on the top floor of the building at 109 Court Street, Boston, when Alexander Graham Bell was carrying on his experiments. There was no need for the wire to be insulated, for the simple reason that this first telephone system was all under one roof. But when telephone wires "went outdoors," it was only natural to hang them overhead—supporting them on glass knobs attached to roof tops and, later on, to wooden poles and crossarms. Thus was born the familiar open-wire type of construction that is still giving good service today.

The drawbacks of open wire construction soon made their appearance, however. In urban areas, where telephone growth was spectacularly rapid, the time quickly arrived when it wasn't practical to add more wires to the line. The poles simply weren't tall enough to hold additional crossarms. Furthermore, the maze of wires on city streets became an eyesore and a telephone man's nightmare. Sleet and windstorms played havoc with the wires, and the need for something better was obvious. Invention of telephone cable certainly was mothered by necessity. Though the process of cable manufacture has been refined thousands of times, early production of cable was basically the same for many years: insulating each wire with a paper wrapping, forming several wires into a bundle (or core), and covering all this with a protective lead sheath. Now the mass of wires could be replaced by a single cable in the air. Better yet, such cable could also be placed underground, because the lead sheath would keep the wires dry.

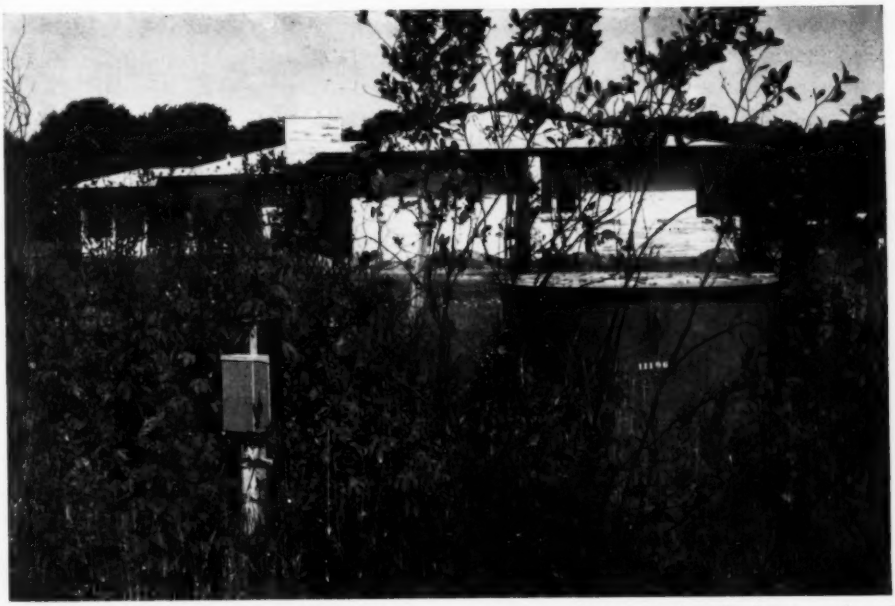
Cable in the air still had to be supported by poles, wires from the poles to

the subscribers' premises continued to clutter the landscape, and the combination of power wires and telephone cables and wires did nothing to improve the view. As long ago as 1889, the Chicago "city fathers" included a clause in the franchise granted the Chicago Telephone Company which designated a large section of downtown Chicago as an "underground area." Other municipalities have similar requirements. The idea of putting telephone plant underground, like water and gas pipes, is not new at all.

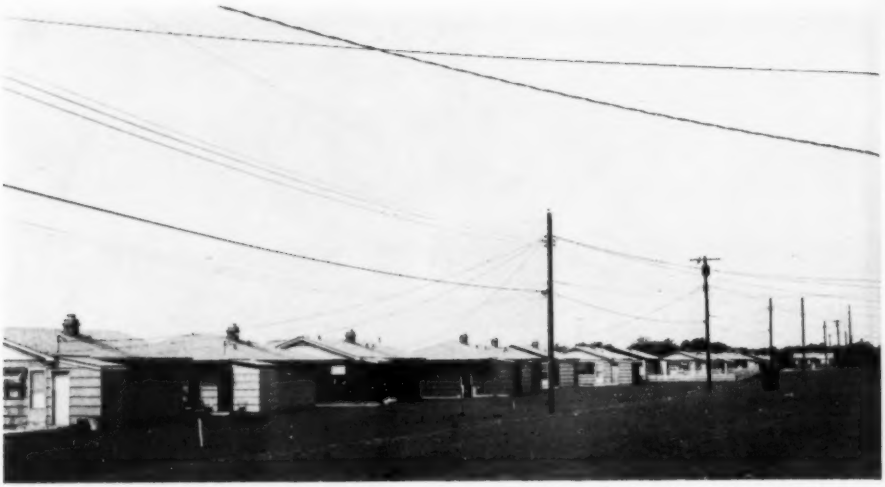
In most business areas and in some residential areas, outside plant—both feeder and distribution—has been almost completely underground for many years. In general, this has involved higher costs. But telephone users knew that their trees wouldn't have to be trimmed in order to keep the branches from touching the telephone wires. They knew, too, that sleet

Poles and wires were once a feature of the Chicago scene. This is LaSalle Street looking South from Washington Street in the days when horse power propelled carriages.

This is a buried installation at Olympia Fields, Ill., as completed in 1955. The telephone pedestal terminal is in the left foreground, and a transformer housing at the right.



The Olympia Fields installation as it appeared a year later. Both telephone pedestal and transformer housing are well concealed by shrubbery and undergrowth.



This is a conventional rear-lot distribution system, using poles with overhead telephone and power facilities.

storms, floods, and winds wouldn't put their telephones out of commission if the connecting wires were snugly buried. People wanted this improvement many years ago, and we know they still want it —but not the higher costs. Because of the cost factor, aerial construction has continued as standard procedure in most of our residential areas.

Recent events, however, are causing telephone people and others to reappraise the place of aerial plant in this modern era. New developments in techniques and materials offer hope that cables and wires may be placed directly in the earth at a price competitive with the cost of aerial construction involving poles, anchors, strand, and overhead drop wires.

An Inherent Difficulty

THE LEAD-SHEATHED, paper-insulated type of cable was an extremely satisfactory product. But a hole in the sheath would allow moisture to enter the cable, and water in a cable usually means trouble. After years of seeking, a wire insulation has been found which is completely moisture resistant. The Bell Telephone Laboratories, in its unending search for a better way, has adapted a method of coating each wire in a cable with a plastic called polyethylene. These plastic insulated cables (called PIC cables) apparently are the answer to the problem of making a cable which is not likely to get into trouble because of moisture unless the plastic insulation on the wires is damaged and broken. The plastic, polyethylene, is the same material which was introduced as a substitute for lead cable sheathing after World War II. Polyethylene-aluminum sheath, with its reduced weight, chemical stability, and ease of handling, has now become the preferred cable sheath.

For many years, before the development of plastic sheathed cables, lead sheathed cables with a jute coating and often with a covering of steel tape armor had been buried in the ground. The Bell System companies started to bury cables, by plowing or trenching, some 25 to 30

This buried telephone and power distribution is in a development at La Grange, Ill. Power transformers are in small housings along the rear-lot line.

years ago. Most of the early buried cables provided inter-city facilities which otherwise would have been constructed of open wire or aerial cable on pole lines. Most of us remember seeing pictures of plow trains in operation, including the "Mickey Mouse" train used by the Long Lines Department in the early 1940s to place the first transcontinental toll cable west of the Mississippi River.

The experience gained from these earlier buried cable jobs and others of a similar nature indicated appreciable economies; but, most of all, these jobs paved the way for storm-proofing our major inter-city facilities. They also suggested to some imaginative engineers that perhaps cable and wire for rural telephones could be placed by the plowing technique at a lower cost than for a pole line. Courageous engineers and construction forces, working as a team, went ahead with the idea and hundreds of miles of wire and cable were plowed in to bring service to rural and other remote areas.

Now, with both an improved wire and the new PIC cables available, thousands of miles of rural plant, instead of hundreds, are being plowed in every year throughout the Bell System. This economical type of construction is making telephone service possible for thousands of farm families. The Michigan Bell and Southern Bell telephone companies have been leaders in this constructive approach to the problem of providing telephone service in rural areas.

The Urban Problem

THE INITIAL USE of plastic-insulated cables in buried rural systems indicated opportunities for economies in the conductor joining techniques and in the terminating arrangements. Here again, the Laboratories went to work on the problem and, in coöperation with the operating telephone companies, produced some very practical and economical improvements. Through continued development work, full economical realization of this type of rural construction is assured.

Early in 1953, it occurred to us that perhaps some of these buried construction methods could also be used to advantage to provide service for city folks. Again, the cost factor! Buried systems proved to be economically sound for long-haul cables and rural cables; but conditions were somewhat different in the cities, with their paved streets, underground pipe networks, and small building plots. Certainly the big plows and tractors used in rural areas weren't practical for use in confined quarters.

Perhaps trenchers instead of plows? But we didn't know of any trenchers which weren't expensive, and all of these dug up far more earth than seemed necessary in order to place a wire or cable no bigger around than a thumb! So we discussed our problem with several trencher manufacturers. What we thought we wanted for this job was a small machine, probably not much larger than a power mower, that would cut a slot two inches wide and 30 inches deep at a speed of five feet per minute. It also should be able to pass through a garden gate and should not ruin a good lawn.

We soon found out that, to the trencher manufacturers, all this seemed to be backward thinking. Just like the automobile manufacturers, makers of trenching machinery were trying to build them "bigger and better." There also was considerable doubt that a trencher meeting these specifications could be made to work satisfactorily.

However, within a year, a model trencher was built and demonstrated. To the manufacturer's surprise and to our satisfaction—it proved that the idea was practical, and that the implement could dig a trench. But it dug up a lot of problems too—due primarily to differences in soil compositions. Is it possible to design one machine that can work satisfactorily under all conditions – from soft sand to hardpan and gravel, from the soft wet earth of spring to the hard frozen ground of winter? We still think it can be done, and recent trencher improvements seem to bear this out—although the telephone companies have found it desirable to go to a somewhat wider and deeper trench. There is still much to be done; but we've come a long way in slightly more than two years, and present progress is most encouraging.

Preparing to terminate buried cable. Work is all done on the ground.

All-Buried Service?

WITH TRENCHER development work well under way and with PIC cables in all gauges soon to be in production, the time finally arrived for concentrated thought on the matter of an *all buried urban residential service.* With the background of experience on inter-city and rural cables and with the tremendous amount of new residential construction under way or forecast for several years, urban developments beckoned.

And so our next engineering step was to estimate costs for various types of aerial and underground facilities for serving urban housing developments. These studies covered over 1100 lots in actual subdivisions and were made by three Operating Companies on the basis of methods, tools, and material then available and in use. These studies presented a challenge to get costs of underground facilities down under costs of aerial counterparts in a majority of cases. This, we knew, would require the development of new techniques and apparatus to meet the lower-cost objective. We soon found that the modern subdivision, with its winding roads, dead-end streets, and irregular lot lines required more poles and many more guys and anchors than the rectangular block layouts of an earlier day. These additional poles, guys, and anchors increased the cost of overhead plant appreciably.

A development near Baltimore, Md., which is being served by buried telephone facilities and overhead electric wires.

Regional Conferences Held

To SOUND OUT the telephone companies on the subject of all-buried service, three regional conferences were held in the summer of 1955. Latest developments in trenchers, modified terminals, new splice cases, and improved work methods were demonstrated. The first of these conferences, held at Olympia Fields, Illinois, included an actual subdivision installation. Similar meetings at Princeton, New Jersey, and Berkeley, California, later in the summer, also explored the buried urban service problem.

Out of these discussions and demonstrations came a number of very worth-while suggestions. Some required development effort by the Bell Laboratories and production of new materials by Western Electric on a rush basis. Others were directed toward organization for greater effectiveness; as an example, a working committee composed of representatives of Bell Laboratories, Western Electric, and the Plant and Engineering Divisions of A. T. & T.'s Department of Operation and Engineering was formed to study suggestions, developments, methods, and results. This committee is actively at work on its assignment, reviewing suggestions received, encouraging trials, and keeping our people informed of progress being made and of what others are doing.

Field Activity

FOLLOWING THE 1955 conferences, several of the companies undertook trial installations, using the new trenchers and trying out various methods and techniques. Soon, projects were under way in a dozen or more locations: In Illinois, Michigan, Indiana, New York, Maryland, Minnesota, Wisconsin, California, Ohio, to name a representative list. Studies of actual costs were made to pin-point further development effort. Preliminary data indicated

Trenching for buried telephone facilities near Gary, Indiana. The pole in the background will carry overhead electric wires.

very promising results in certain cases. Where soil conditions were favorable, underground plant has been placed at lower first cost than for overhead construction.

It's one thing to get favorable costs on certain hand-picked locations; it's quite something else to get favorable costs on a majority of all jobs regardless of terrain, weather, and other conditions. Heavy rock, shale, and other formations may make it impractical to bury plant in some locations. Regarding the northern winter problem two lines of attack offer promise. The first is better planning, scheduling, and coördinating to insure that buried plant is placed before the ground freezes. The other possibility, which is receiving major attention, is further improvement of trenching equipment to assure satisfactory operation under conditions of frost and frozen ground.

Service

BUT WHAT ABOUT such matters as maintenance expense and reliability of service? There is no doubt that maintenance expense will be lowered. That has been the experience in the companies that have made extensive use of PIC cables in rural areas. As to reliability of service, review of cable trouble results over the past several years shows considerably less trouble per 100 sheath miles of buried cable than for aerial cables.

For buried systems, there will be no tree interference, no poles to decay, no strand and lashing wire to rust, and sleet and wind can do no damage. Only the gardener's spade, the fence post, and the "do-it-yourself" fan loom as natural enemies of buried plant in the yard of the city dweller. Field experience will serve to guide us in selecting locations to re-

duce likelihood of damage. Buried construction will also be safer to build and maintain. There will be no poles or ladders to climb, no strand to ride—all work will be done on the ground.

The availability of timber suitable for poles has been an increasing problem in recent years. Extensive use of buried systems will not only minimize the problem of obtaining suitable pole timber but will work toward conservation of the natural timber supply for purposes where satisfactory substitute materials are not available.

Joint Action

A QUESTION frequently asked is "What about the power companies?" Obviously, a builder or developer, and a home buyer too, are interested in having all power and telephone wires and cables underground, not just one or the other. Appearance factors and service reliability all point toward underground plant. A subcommittee of the Edison Electric Institute-Bell System Committee on Plant Coördination, consisting of power company representatives and telephone people, is jointly reviewing all aspects of underground power and telephone service. There are many common problems requiring the same kind of cooperation and study that was required in the early days of joint pole usage. In general, the power companies are interested. The power people have some real problems, such as increasing residential loads due to appliances and air conditioning. Street lighting requirements also complicate the problem. The presence of gas, water, and sewer pipes also introduces problems that must be considered. Perhaps, as in the case of the EEI-Bell System Subcommittee, joint studies with other national associations will be required.

This terminal, being installed by the Michigan Bell Telephone Company, was provided by the Southern Bell Telephone and Telegraph Company.

In Sum

BURIED TELEPHONE SYSTEMS for new residential areas are a natural outgrowth of the System's experience with buried intercity and rural cables. The techniques, materials, and tools now available provide an opportunity to study, experiment, and develop.

We must consider appearance. We must consider service, for we cannot permit telephone lines to be destroyed by the fury of winds and the weight of sleet and ice on overhead lines. So we must recognize that low-cost all-underground plant is definitely needed. Hundreds of homes in new developments were served in 1956 by completely underground or buried plant; thousands will be so served in 1957.

What about future service require-

A completed terminal installation. At pedestal locations such as this, buried service wires are connected to cable pair terminations.

ments? A buried system must be designed for a long service life and a different distribution pattern used. Since new and added services will be coming along during the life of the buried plant, the engineer will need the assistance of the merchandising forces. And he must really polish up the old crystal ball to make sure that the plant provided now will take care of party line upgrading, additional lines, and the likelihood of new types of services.

Most of all, we should not become discouraged if the costs are higher than expected on some early jobs. If higher costs should be experienced, let us take the opportunity to analyze our methods. Further, the temptation to dress up the plant with frills that add nothing to the service and run up costs must be resisted. Let's move ahead with what we now have, experiment while we have time, and incorporate improvements that give promise of better service, greater safety, improved appearance, and lower construction costs.

A guest editorial

FOCUSING ON OUR CUSTOMERS' WANTS

H. I. ROMNES

Vice President, OPERATION AND ENGINEERING, A. T. & T. CO.

THERE'S NEW EMPHASIS throughout the Bell System on providing our customers with a greater choice of attractive communications instruments and services. To help implement this, a Customer Products Planning Division has been set up in A. T. & T.'s Operation and Engineering Department. And this is tied in with the development, manufacturing, and merchandising organizations of the System through a new Customer Products Advisory Board.

Over the years, the Bell System has placed major emphasis on providing a basic telephone service which is

universal in coverage
fast in operation
high in quality
low in cost

We've made enormous strides along this path since the war. Let's look quickly at some of them:

We have increased the number of Bell System telephones from 22 million to nearly 50 million and households with telephone service from 50% to 80%.

We have expanded the long distance network three-fold and made it truly world-wide by interconnection with 112 overseas countries and territories, so that 97% of the world's telephones are now within reach.

We have nearly completed conversion of our local service to dial. Starting from scratch at the end of the war, we have equipped two-thirds of the long distance network for dial operation.

We have built a nation-wide carrier network, operating over coaxial cable, radio relay, and underseas cable paths. In addition to providing plentiful long distance service, this has improved telephone quality so that it closely approaches face-to-face conversation.

With all this, the *relative* cost of telephone service is much reduced. Typically, a family can have individual line telephone service at a cost per month equal to what a factory worker earns in 2½ hours, compared with 5½ hours before the war.

Incidentally, in doing this job, the capital invested in the Bell System has increased from just over $4 billion to nearly $15 billion during the eleven post-war years.

These have been great achievements, and telephone people are proud of them. But for our customers they have not had the dramatic impact of, for example, each year's new model automobiles. For our advances have come gradually, with the new devices largely behind the scenes.

For the future, we are putting increased emphasis on the things which are "on stage" – the things our customers see in their homes and where they work. Our present opportunity for serving the public even better is to stimulate greater usage of our vast communications resources. We can do this by offering a wider choice in instruments to make it easier and more pleasant to use existing forms of communication more freely, and by developing new kinds of communication such as the transmission of pictures and of "machine language" for the operation of high-speed computors.

This isn't a sudden new concept. Our customers already find colored telephones attractive, and want to place more of them where they visibly are near by. Speakerphones make talking over the phone seem easier, more natural. Customers have discovered that answering-recording sets make telephones useful even when nobody is at hand. For business use, data transmission already is opening a whole new field of service for our communications networks.

These are just a few examples of what is being done. But with all this, there is no limit to what still can be done. Hence, the new customer products planning organization.

How the Customer Products Planning Division Operates

THE DIVISION gathers ideas from every source, both within the business and outside it, about what telephone customers might like. It develops working models embodying the ideas that show the most promise. It arranges for market tests of the best of these, to see whether the product fully meets customers' wants and needs and will be in good demand at a satisfactory price. Finally, those products that make the grade are turned over to the appropriate parts of the Bell System organization for final design, production, marketing, and installation.

One section of the new division handles new products in the field of telephony. For example – a small-size bedside telephone, inexpensive arrangements for communicating within a home, new forms of hands-free telephones, simple automatic dialing devices, and a lot of other telephone communications applications.

Another section deals with teletypewriter service, data transmission, visual communications, remote control and metering services, and the many other possible uses for the Bell System network.

The third section is responsible for accumulating and analyzing ideas for new customer instruments and services and for planning and coördinating market tests.

Much of this, of course, has been done over the years by various parts of our organization—as evidenced by the accomplishments of the past. But with the widespread availability of basic telephone services, it seems timely that we have a group which can concentrate its full attention on planning of customer products – people who can devote full time to looking forward, developing new ideas and casting about in unexplored fields, without the distractions of a multitude of pressing day-to-day problems.

The Advisory Board

THE Customer Products Planning Division clearly cannot work as an isolated group. It must tie-in at all stages with many other parts of the Bell System organization.

To facilitate this, a Customer Products Advisory Board has been established. It is made up of the man who is responsible in the A. T. & T. Merchandising Department for marketing methods and tech-

niques, the vice president of the Bell Telephone Laboratories in charge of development of telephones and related equipment, the works manager of the Western Electric factory producing telephone station apparatus, and the director of the Customer Products Planning Division. Alternate members are another vice president of Bell Telephone Laboratories and a vice president of the Teletype Corporation; they take part in considerations of teletypewriter, data, and other nontelephonic apparatus and services. Outside styling consultants, both men and women, are brought into the picture, to be sure that our designs fit in with modern trends in office and home planning. This Board will not only advise but one or another of its members will be in a position to take positive and prompt action to expedite the development and production of the new items, since they are the responsible heads of the organizations which can carry out what needs to be done.

And Finally . . .

HERE WE HAVE a new division, created for an important purpose, staffed by able people, in touch with the development and manufacturing and operating sections of our business, supported by an advisory board, advised by outside consultants. What more is needed to insure the success of the enterprise?

One more element is vital.

It is the personal interest of Bell System men and women everywhere in contributing their ideas and suggestions toward making telephone service and equipment more useful and more pleasing to our customers.

As we undertake to transmit voice messages by cable beneath vast depths of ocean, new hazards arise to be recognized and provided against or avoided

THE SEA AROUND OUR CABLES

ELDON NICHOLS

Project Manager, ALASKAN AND PACIFIC CABLES, LONG LINES DEPARTMENT, A. T. & T. CO.

"Between the sunlit surface waters of the open sea and the hidden hills and valleys of the ocean floor lies the least known region of the sea. These deep, dark waters, with all their mysteries and their unsolved problems, cover a very considerable part of the earth. The whole world ocean extends over about three-fourths of the surface of the globe. If we subtract the shallow areas of the continental shelves and the scattered banks and shoals, where at least the pale ghost of sunlight moves over the underlying bottom, there still remains about half the earth that is covered by miles-deep, lightless water, that has been dark since the world began."°

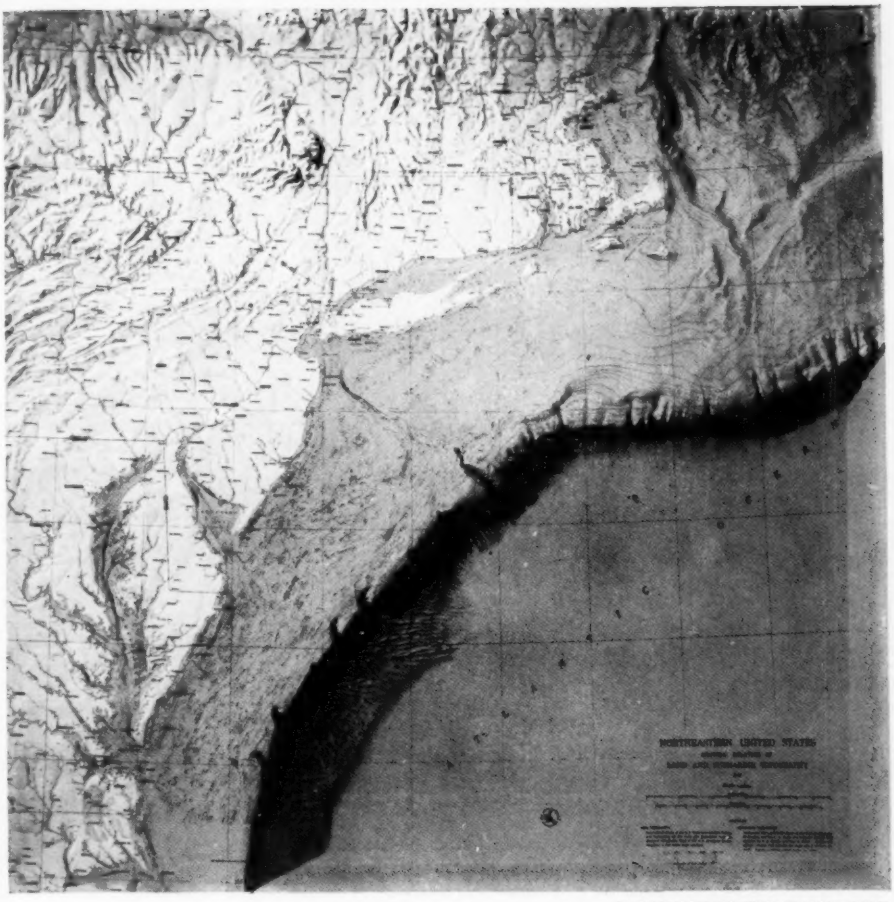
THE AIR AND THE EARTH are two of nature's elements which have long received the bearers of man's spoken messages: the air since open-wire telephone lines were first strung from roof-top to roof-top in the earliest days of Bell's "speaking telegraph"; and the earth from the time when cables were taken down from poles and buried in the ground.

Now telephone cables are being entrusted to still another element: the sea. The arduous task of laying twin telephone cables between North America and Great Britain has been successfully accomplished, and conversations flash back and forth beneath the Atlantic's waves in smooth routine. The Alaskan cables followed, and were opened for service on last December 11. The Pacific has already been plumbed and charted in another direction, and twin cables to the Hawaiian Islands are to be laid this year.

With the first two of these elements—air and earth—telephone people are rather familiar. They know how to deal with them to best advantage: what the principal hazards to their circuits are, and how to guard against them.

Not so with water—the ocean. This is pretty much a new medium to them, and while there is a great and historic body of information about Oceanus and all his seven seas, and even some experience applicable to submarine telephone cables, deep water is still strange to telephone

°From "The Sea Around Us." Copyright 1951, Rachel L. Carson. Published by Oxford University Press, New York.



RELIEF MAP BY AERO SERVICE CORP.

Northeastern United States: a representation of the relationship between the land, the gradually sloping continental shelf, the abrupt pitch of the continental slope, and the ocean depths which extend for miles beyond.

men. It is natural, then, that since the transatlantic submarine telephone cable became a real probability, we have been learning all we can about conditions in the oceans: particularly what may cause damage to cables and interrupt service, and how to avoid or overcome the causes.

Such information we have been gaining from a variety of sources. There is the history of submarine telegraph cables, which first came into use more than a hundred years ago, and the experience of the officers of present-day cable ships. There are the published works of oceanographers and other scientists, and the discussions we have had with a number of these gentlemen. There is our own experience, still rather slight but rapidly increasing, with the planning and laying of the new cables and, of course, with older but shorter submarine cables—particularly those between Key West, Florida, and Havana, Cuba.

Oban, on the mainland east of the Isle of Mull, where the transatlantic cable terminates, doesn't appear on this eighteenth-century map of Scotland, drawn and engraved by cartographer R. W. Seale

Some of the things we have learned have proved not only important but interesting to those of us who have sought them out. Perhaps you will find them so too.

A convenient way to cover our subject is to begin at the cable terminal building (near where the cables come ashore—or put to sea, if you will), and continue down to the shore and on through the water to the deep ocean floor, stopping to consider

each of the possible hazards we find along the route.

The terminal building is usually located quite close to the shore, in part to keep the cables as short as possible but principally because any damage to them by construction workers or others could result in a power surge that might destroy the nearest submarine repeater. The cables are buried deeply all the way from the terminal building down to the shore, across the beach, and to a point below the low tide line.

From land to water

IDEALLY, the cables should enter the water from a sandy beach in a sheltered location where there is little or no surf. In some cases however, the only sheltered waters available are frequented by vessels, which may damage the cables with their anchors; or they are at the mouths of streams, where masses of silt, or floating logs borne by spring floods, might cause trouble. Consider, for example, the California coast, where the cables to Hawaii will land. Here, the best landing site is an exposed beach where the prevailing northwest winds cause heavy surf. Fortunately, divers who checked the bottom for us found there are no rocks against which the cables might be chafed by the waves. It is expected that the shifting sand will soon cover the cables, but that at times they may again be uncovered by storms. To strengthen and protect the cables, they will be covered by two layers of heavy galvanized-steel armor wires.

LAMONT GEOLOGICAL OBSERVATORY

A submarine photograph of an unnamed seamount in the Mid-Atlantic Ridge

In some areas, icebergs may drift over a cable and run aground in shallow water, grinding the cable against the bottom. During the laying of the west-to-east transatlantic telephone cable in 1955, an iceberg appeared unexpectedly in Trinity Bay, Newfoundland—an area previously free from them—and it was necessary to detour around it. Fortunately, the water was deep enough to float the iceberg away without causing any damage.

Where land and ocean come together there is in most places a broad, slightly sloping, flat plateau, called the continental shelf, over which the water is less than 100 fathoms deep. (A fathom is six feet.) On our Atlantic Coast this shelf is some two hundred miles wide; on the Pacific Coast it is more likely to be twenty—both figures varying considerably with the location.

Wherever the continental shelf is smooth and free from rocks, we are likely to find commercial fishermen operating "beam" or "otter" trawlers. These are sturdy, powerful vessels which drag large nets equipped with weights to hold them down close to the ocean bottom. (On the Pacific Coast beam trawlers are generally called "draggers.") At the outer corners of a trawler's net are two large "otter boards" made of planks and weighted with steel shoes which slide along on the bottom. The otter boards are rigged like kites, so that they tend to pull away from each other, holding the net wide open. Cables, particularly old ones weakened by corrosion, are often damaged when an otter board is dragged over them; even a strong new cable may be caught on the end of an otter board and pulled up to the surface—where the fisherman may cut the cable to free his tackle.

Wherever possible, we route our cables

Cable awaiting entrenchment in Newfoundland.

It wasn't Alaska when Capt. James Cook charted the region in 1788 and 1789, and Ketchikan is a relatively recent addition. Reproduced from "Captain Cook's First, Second, and Third and Last Voyages . . . London: Printed for the Proprietors, and Published by Alex Hogg at the King's Arms, No. 16, Pater Noster Row . . ."

through areas where trawlers cannot operate because the bottom is too irregular or rocky. Although we must avoid rocks in rough shallow water, where waves would scrape the cables against them, there is little or no wave motion at depths of more than 18 or 20 fathoms, so that rocks are not particularly harmful under these conditions. Additional measures to guard against trawlers are being studied and an active program is being planned. This will include efforts to inform all operators of trawlers of the locations of our cables and to enlist their coöperation.

Marine borers, particularly teredos or "shipworms," are potential enemies of our cables in water of shallow and moderate depth. The shipworm, which is not a worm at all but a relative of the clam, attaches itself to a submerged object, usually wood, and drills a deep hole which is used as a home or shelter. Since teredos might drill holes into our cables between the armor wires, we use a "teredo tape" of copper around the return tapes which form the outer conductor. The teredo tape is wrapped on tightly, with overlapping joints, and is expected to give complete protection.

Another enemy from the animal world, on rare occasions, is the whale. The sperm whale has a peculiar habit of diving to depths as great as half a mile and burrowing into the soft bottom. In several instances, cable ships dispatched to repair a broken cable have found the remains of a whale entangled in it.

To greater depths

When the gradually sloping continental shelf finally reaches a depth of between one hundred and two hundred fathoms below sea level, the bottom begins to descend at a much steeper angle. This region

The breaking waves dash high on a stern and rockbound California coast, just as they do on the New England shore

is called the continental slope. In routing our cables here, we try to avoid the steepest places; because here the cables may be under excessive strain, or great quantities of mud or sand may have accumulated, in readiness for a submarine landslide that will carry away any cables that are in its path.

Cutting through the continental shelf and slope are many submarine canyons which, if they were exposed to our view, would rival or surpass the great canyons of our western states. We avoid these sea canyons, since the cables might be exposed to abrasion from currents carrying silt. There is also the danger of sharp rocks at points where the cables are suspended.

It is easy to picture a submarine landslide of sand or mud slumping down a steep underwater slope. Not quite so simple in concept is the "turbidity current". If silt consisting of particles of sand, which are much heavier than water, begins to tumble down a submarine slope, the result may be quite different from the slide which our experiences above water would lead us to expect. The heavy particles of silt, instead of sticking together, may be separately suspended in the water, forming a mixture much heavier than water but not at all sticky, and behaving more like mercury than like mud. A turbidity current of this kind may flow initially at a speed as high as sixty miles an hour, and may travel several hundred miles out across the nearly flat ocean floor before finally coming to rest.

It is pretty well established that it was such a current as this, starting on the Grand Banks of Newfoundland on November 18, 1929, and sweeping into the Atlantic, which carried away all the transatlantic telegraph cables. In some instances as much as two hundred miles of cable could not be found and had to be replaced.

Point Arena, Cal., complete with light house, is typical of a coast where a landing place for the telephone cable to Hawaii had to be found

Those whose work is involved with ocean deeps sometimes encounter two questions that seem to trouble people. First, does a cable or other object really sink all the way to the bottom, or does it somehow reach a state of balance part of the way down, and remain suspended there? The answer to this is that any object that is heavier than an equal volume of water will sink, and since the density of water changes very little with depth, practically any object which sinks beneath the surface will go all the way to the bottom. In fact, many objects will be crushed together into smaller volumes by the pressure of the water after they have sunk part of the way, after which they will sink faster. Of course an object that is lighter than an equal volume of water will float, part of it projecting above the surface.

The second question is, how do we know the depth of the ocean, since divers and submarines can descend only a few hundred feet below the surface? The depth of

GEOLOGICAL DIVING CONSULTANTS INC.

Skin-divers succeeded in finding a beachhead for the cable

Modern Submarine Telephone Cable Systems

In each system, the main span consists of two one-way cables, like the two separate roadways in a modern superhighway. Each cable has only a single central conductor, surrounded by polyethylene insulation and an outer return conductor made of copper tapes. However, thirty-six telephone conversations may be carried on at the same time by the use of carrier techniques. This is another way of saying that at each end of the cable system there are thirty-six small transmitters, each operating on its own frequency assignment like a tiny radio broadcasting station. The radio signals from these transmitters, instead of being broadcast, are directed into one of the cables and travel through it to the distant end, where there are thirty-six receivers. Each of these receivers is tuned to the frequency of one of the distant transmitters. In this way thirty-six separate two-way voice channels are obtained.

Since the signals weaken rapidly during their trip through the cable, vacuum tube amplifiers or repeaters are inserted in the cable during manufacture at intervals of about 40 miles and are laid on the ocean floor. The amplifiers have vacuum tubes designed for very long life, and are housed in flexible copper tubes supported on the inside by steel rings which are little larger than the cable itself.

Power for the vacuum tubes is transmitted through the cables from terminal stations on shore at both ends; these stations also contain the carrier equipment which prepares the 36 voice currents for transmission through the cables and separates them from each other again at the other end.

(A non-technical description of the manufacture and laying of the transatlantic cable may be found in the Bell Telephone Magazine for Summer 1955.)

the ocean was once measured by lowering a weight at the end of a line until an abrupt reduction in the tension on the line indicated that the weight had touched bottom. Each measurement made in this manner in deep water took an hour or more. Now a sonic depth measuring set, or echo sounder, does the job in a few seconds. A very loud "ping" of sound is shot downward from a device in the bottom of the ship's hull. The sound travels to the ocean bottom at a speed of about 800 fathoms per second and part of it returns to the ship as an echo. The time required for the round trip is measured and recorded automatically on a chart. Since "pings" are sent at short intervals, a profile of the ocean bottom along the course followed by the ship is traced upon the chart.

Mountains of the depths

Rising from the deep ocean floor are many isolated submarine mountains, called seamounts, and numerous long ranges. There is, for example, a continuous mountain chain in the Atlantic extending from the Arctic Ocean to the Antarctic, breaking the surface at intervals to form islands. This range had to be crossed by the transatlantic cables, of course. The route of the cables to be laid between California and Hawaii next summer crosses the Murray Fracture Zone. This is a little-explored submarine ridge extending westward across the Pacific from the California coast. Present indications are that this great seam may prove to be even grander in scale than the better known Mendocino Fracture Zone, farther north, which contains a steep slope or escarpment a mile high and a thousand miles long. However, crossing points have been found at which the slope will not be excessively steep.

In addition to the many ridges and sea-

mounts, there are, particularly in the Pacific, odd cone-shaped mountains with flat tops, called guyots. Apparently these guyots once were volcanoes which rose above the surface of the sea to form volcanic islands. Through ages of exposure to wind, rain, and waves, the part above the surface eroded until the island was quite flat. Then finally the whole volcanic cone and the nearby ocean bottom sank, submerging the island completely.

We detour our cables around submarine mountains and ridges wherever we can, because of the danger of breakage on their steep, rough slopes. Another reason is the possibility that they may contain outcroppings of copper or other metals which, in salt water, might set up an electrolytic action that would cause the cables' armor to corrode and disappear rapidly.

Not all of the ocean floor is mountainous, however; a great deal of it is deeply covered with sediment, forming great flat areas called abyssal plains. This sediment, which has been settling down through the water for millions of years, consists mainly of silt from rivers, dust from volcanic eruptions and other sources, and the shells and remains of countless tiny plants and animals, called plankton. This kind of ocean bottom furnishes an ideal bed for a cable, and its smooth, undisturbed surface gives evidence that there has been no volcanic activity in the recent past.

The possibility of a volcanic eruption occurring on the ocean bottom under or near a cable has been studied recently because of several reports from pilots of aircraft in the vicinity of the Hawaiian Islands. These observers reported seeing

Ocean deeps: a greatly exaggerated profile of the heights and depths which the telephone cable will encounter as it approaches the Hawaiian shore.

masses of brown, yellow, and green material on the surface of the ocean. In one case it was first thought that a new island had risen from the ocean floor at a point about 750 miles northwest of Honolulu. After a few days, however, this "island" disappeared, and it is now believed to have been floating material, possibly volcanic mud or ashes.

In the most recent case of this kind, it was later reported that the floating material was not of volcanic origin at all but was a floating mass of marine plants known as algae. At any rate, the probability of an eruption occurring close to any particular cable route is exceedingly remote.

Earthquake hazards

SUBMARINE EARTHQUAKES have occurred frequently in some areas, notably along the route of the Alaskan cables, according to calculations based on seismograph records obtained at a number of observatories. Seismologists have told us that the centers of most of these disturbances are several miles below the bottom of the ocean floor, and that it is unlikely that many of them result in cracks or fractures on the ocean floor that would break a cable. Nevertheless, we avoid earthquake areas wherever we can.

In addition to these earthquakes beneath the ocean floor, the possibility of damage near the shore had to be considered in one instance. This was the selection of the landing site in California for the cables to Hawaii. The site finally chosen is on the western, or seaward, side of the only fault line in the vicinity, which is known as the San Andreas Fault, and so a slippage along this line would not be likely to break our cables. Incidentally, the San Francisco earthquake of 1906 was caused by a sudden major slippage along the San Andreas Fault. It runs parallel to the coast line north of San Francisco, and at present the land and the nearby ocean bottom west of the fault—which will include our cable landing and terminal building site—is moving northwestward about two inches a year with respect to the rest of the United States.

Any object submerged in the ocean is constantly pressed on all sides by the weight of the water above. The pressure in pounds per square inch is equal to the weight of a column of water one inch square extending all the way up to the ocean's surface. The significance of this rather dull statement is that in some parts of the Pacific, where our cables will be laid in water as deep as three thousand fathoms, the pressure on every square inch of the surface of the cable and repeaters will be about 8000 pounds. This great pressure has made it necessary to enclose the vacuum tubes and other delicate components of each repeater in a very strong cylinder made of overlapping steel rings, and to seal the ends of the cylinder with extreme care.

Weight, depth, tension

WHEN CABLE is being laid in very deep water, the tension at the upper end becomes quite high because of the cable's own weight. And if it becomes necessary to pick up the cable later for repairs, the tension is generally about twice as high as the laying tension. Along the deeper parts of the route to Hawaii the picking-up tension will be around 25,000 pounds, with an additional surge of two or three thousand pounds whenever the cable ship is lifted by a wave. To keep the cable from breaking under such high tensions, the armor wires used in the deep-sea sections are being made of special high-strength steel. Little could be gained by increasing the diameter of the armor wires, for this

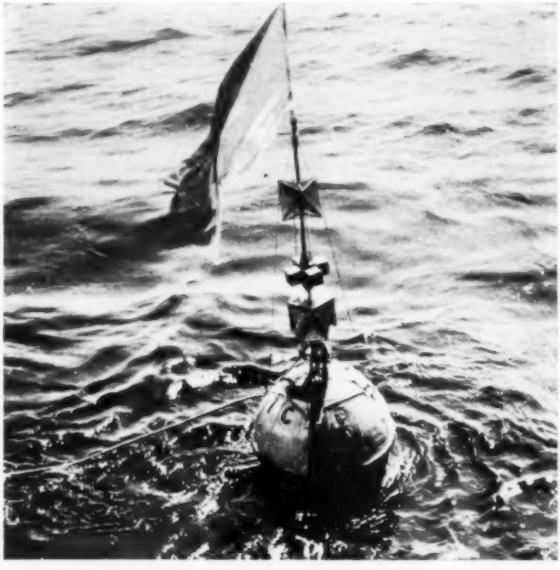
He discovered the Hawaiian Islands in 1778, and named them Sandwiches – for the Fourth Earl of Sandwich. Reproduced from "Captain Cook's First, Second, and Third and Last Voyages . . ."

would increase the weight as well as the strength. When a splice must be made in the cable, it is essential that the armor wires be overlapped and wrapped in such a way that the splice is as strong as the cable itself.

The ocean's greatest depths are found not in the middle, as we might expect, but in deep trenches near chains of islands. The deepest spot now known, the Marianas Trench, has a depth of 5,940 fathoms, or nearly six nautical miles. Other deep trenches lie near the Aleutians, the Philippines, and the West Indies. Although we have no need at present to lay cables across or around any of these trenches, they affect our plans in a peculiar way. The ocean floor at the bottoms of trenches seems to be in a state of unrest, and at times it suddenly rises or sinks. When this happens, the displacement of the vast quantity of water above generates a series of great waves. These waves, known by the Japanese name "tsunami" but often miscalled tidal waves, rush across the ocean for great distances at speeds as high as five hundred

miles an hour. When such waves arrive at a distant shore, they cause the water to rise and fall to levels far above and below the normal tides, sometimes causing great destruction. The Hawaiian Islands have experienced tsunamis from several of the island trenches in the Pacific. In 1946 a particularly severe one rushed in from the Aleutian Trench and the sea rose as much as fifty feet above normal at some parts of the coast line. To guard against damage from this source, the cable terminal building in Hawaii is being built on a hillside 130 feet above sea level, far higher than any tsunami ever experienced there.

GETTING OUR FEET WET is a relatively new experience. Still unknown problems may lurk in the depths—and we are quite certain that we haven't found all the answers to the hazards we face. But we have the utmost confidence in our submarine telephone cables—in service, a-building, and to come—and they form an incalculably important addition to the telephone networks by which people everywhere may speak with one another and hear one another's words and tones. That is why we have reported here something of our progress in the search for ways to protect the new submarine cable systems.



REPRINTS FROM THIS *MAGAZINE*

More than 600,000 copies of reprints of 19 articles first published in the Bell Telephone Magazine in 1954 and 1955 emphasize a development which has been taken pretty much for granted despite its rapid growth in recent years.

There is now no available record, in this Magazine's 35-year history, of the first reprint: of the article which it reproduced, of who wanted it or for what purpose.

How many articles from the Magazine have been reprinted and how many copies

1954—1955
REPRINTS
Bell Telephone Magazine
19 articles in 2 years
600,000 copies printed
Average cost 3¢ per copy
PUBLIC FAITH AND RAISING CAPITAL
A Program for CENTRAL OFFICE Administration
Selling our Customers Everything they Need
as helping ourselves TO GROW
The New Bell System TV Program
AT&T
Serving A Nation of Home Towns
TELEPHONE EMPLOYEES AND PUBLIC RELATIONS

have been made since that first unrecorded example? Nobody knows accurately; but there is enough information to spark interesting speculation—and to lead to large totals. The 1954-1955 total of 600,000-plus was derived in the course of a study made for a System conference last Fall. Extend the period a year in each direction and we know that the four-year total would grow to well over a million copies. Even granting that the large development has taken place since World War II, the past 35 years must have seen a good many reprints.

How do reprints come about? Well, some days or weeks after a new issue of the MAGAZINE is distributed, inquiries—calls or letters—about possible reprints of such-and-such article come to the editor from "the field." If there are enough of them to indicate real interest, he writes to all the Associated Companies asking if they want reprints of that particular article, and, if so, how many. When all the orders are in, the required quantity is printed, and shipped as per instructions. It's a rather time-consuming process, but the distribution is really keyed to demand. Incidentally, the cost of reprints is low, averaging about three cents a copy.

The tabulation below of the 1954-1955 reprints reveals a marked characteristic of the activity: its great variety, both quantitatively and by subject.

Some of the Companies operate booklet racks, so called, through which they sometimes distribute MAGAZINE reprints, among other items, to their employees. If several of the Companies use a given reprint for this purpose, then combined demand may amount to 100,000 copies or more. If, on the other hand, an author or a department

(Continued on page 252)

Reprints from the BELL TELEPHONE MAGAZINE

Title	*Author*	*Quantity*
1954		
Public Faith And Raising Capital	*John J. Scanlon*	2,500
Serving A Nation Of Home Towns	*Bartlett T. Miller*	5,000
What Is Science Doing To Electronics?	*Ralph Bown*	35,500
Selling Our Customers Everything They Need	*Eugene J. McNeely*	35,500
A Program For Central Office Administration	*Margaret E. Fawcett*	14,400
"What's Your Telephone Number?"	*Stanley G. Ericson*	54,000
Opportunities Unlimited!	*Jack Clark*	40,000
1955		
Earning The Friendship Of The Owners Of A. T. & T.	*S. Whitney Landon*	16,500
Helping Ourselves To Grow	*H. Randolph Maddox*	40,500
Telephone Employees and Public Relations	*John W. Cogswell*	52,300
Wider Horizons For The Plant Department	*Rudolph Eklund*	31,500
The Independents Today	*Harry Disston*	21,100
Transatlantic Telephone Cable Puts Out To Sea	*C. C. Duncan*	110,000
The Human Side Of Supervision	*C. Russell Deyo*	30,000
Selling Better Service To Business Customers	*William W. Penick*	10,000
How Can We Broaden The Telephone Man's Horizon?	*John Markle II*	3,000
Learning What Telephone Service People Will Need	*John M. Shaw*	21,600
Our Air Defense System	*Maj. Gen. Gordon A. Blake*	10,000
The New Bell System TV Program	*Will Whitmore*	93,500

HEADQUARTERS SUMMARY

Sept. 15 to Dec. 15, 1956.

A NEW P.B.X. system (coded 520A) and related relay equipment are being provided for use in emergency reporting systems provided for municipalities, military installations, and industrial plants. The emergency reporting system enables the public or employees to reach the appropriate authority from specially provided outdoor telephones, to request assistance in emergencies, such as fire, accident, civil commotion, etc.

The 520A switchboard and related relay equipments are available now on order, with the new type outdoor telephone set designed for emergency reporting systems used at the reporting stations. The reporting lines are arranged for continuous electrical supervision of the wire facilities and station equipment to minimize possibility of the line being out of order when needed in an emergency. Audible and visual signals are automatically operated if circuit continuity is broken.

A SIMPLIFIED PROCEDURE for placing credit-card calls became effective in the Bell companies with the issuance of their 1957 credit cards to customers. The new practice contemplates that the calling party will give only the credit card number to the operator, instead of also giving the name of his home city and telephone number. The number of the telephone from which the call is placed will not be required except on calls originating at hotels.

A SIMPLIFIED home communications system has recently been demonstrated. It requires almost no development of new apparatus and consequently can be largely assembled in Western Electric's distributing houses from available material. Its simplicity results in limiting its costs and, therefore, the charges are expected to be low enough to prove attractive in many homes.

The system utilizes several 1-button telephones plus a low-voltage power source (plugged into 115-volt commercial power service) and, optionally, a microphone-speaker assembly. It provides for: talking between any two (or more) telephones in the home; holding an incoming call on the central-office line while reaching over the home communications circuit the desired party; code-calling (by means of the bells in the telephones) any person or location in the home; optionally, by a small amount of added equipment, conversing from any inside telephone to a microphone-speaker telephone at the door – to identify visitors. Field trials are planned in the near future to determine customer reaction and the marketability of the system.

THERE APPEAR to be definite limits in present methods of providing Directory and Information telephone number services. These limits are being rapidly approached in some of the largest cities. There appears to be also a real need to explore possibilities for improving the usefulness and efficiency of these services. To tackle these problems aggressively, a task force of Associated Company people has been organized with varied experience in Directory and Information services. This group is engaged in studying the entire field of telephone number services, gathering suggestions from available sources both in and out of the Bell System.

ON SUNDAY, October 7, three 4A toll crossbar switching systems were placed in service at Memphis, Nashville, and Columbus, Ohio. This completes the 1956 program for new installations of such systems. There are now 44 of these offices in operation in the Bell Companies, and 25 more are programmed for service between April 1957 and the third quarter of 1959.

THE 20th and 21st CAMA installations were cut into service at Milwaukee on November 25 and at Phoenix on December 2, 1956. Customer acceptance of the new service is considered good at each location, and the equipment is operating satisfactorily.

THE A. T. & T. family of share owners grew by some 80,000 in 1956, bringing the total to around 1,490,000—within shooting distance of the 1½ million mark. More than half of the year's net gain resulted directly from the A. T. & T. offering of $572 million of stock to share owners which closed last November. This offer was one of the most successful in the company's history, with 775,000 individual purchases and 99.8 per cent of the offer taken.

Capital added by the Bell System in 1956 amounted to about $1.6 billion, bringing the total added in the post-war period well past the $10 billion mark. Heavy exchanges of

convertible debentures into stock and the stock issue itself combined to produce a record-breaking increase of nearly 8.8 million in A. T. & T. shares outstanding, bringing the total outstanding at the year end close to 63 million. As a result, the ratio of debt in the System's total capital declined from 35 to 33 per cent.

The increase in A. T. & T. shares outstanding is, of course, paralleled by a corresponding increase in the quarterly dividend. The January dividend, for example, amounted to $141.5 million, a far cry from the first $178,500 dividend paid more than three-quarters of a century ago by the old American Bell Co. to its 540 stockholders on January 1, 1881. In fact, the January dividend exceeded the total of all the dividends paid to the public by A. T. & T. and its predecessor during the 29 years from January 1, 1881 through January 15, 1910.

TELETYPEWRITER EXCHANGE SERVICE (TWX) marked its 25th anniversary on November 21. This service is an outgrowth of the private line service which the Bell System has provided for various customers since 1887. Messages to scores of business organizations were sent out by the Associated Companies to firms in various parts of the United States. One of these was transmitted by the first TWX Chief Operator, Mrs. Helen M. Peterson of Long Lines, who sent messages from the New York Company to 65 of its original customers who are still active today. There are about 40,000 entries in the TWX Silver Anniversary Directory; the 330 different types of organizations in the directory include many firms which have been continuous users of the service since its inception in 1931.

ONE OF THE WORLD'S largest indoor animated displays was placed in operation on November 8 in the New York terminal of the Pennsylvania Railroad by Long Lines. It features the slogan: "Enjoy Your Trip! The Telephone Keeps You in Touch." Smaller displays are now in operation at LaGuardia Airport in New York, 30th Street railroad station in Philadelphia, the Cincinnati railroad terminal, and the San Francisco Airport.

A PLAQUE commemorating the fiftieth anniversary of Lee de Forest's invention of the audion – a three-element electron tube – was unveiled on November 12, 1956, at the site of the old laboratory where it was invented, now 229 Fourth Avenue in New York. Several years after its invention, the audion's amplifying ability was demonstrated to Bell System engineers, who realized that such an amplifier of electric currents could overcome the distance limitation on the transmission of voice communication. Rights under de Forest's patents were acquired by the Bell System, the audion was developed as a high-vacuum tube by the late H. D. Arnold, and in July of 1914 transcontinental conversation was made possible by those amplifiers—which have been used in countless millions in Bell System plant since that time. The Laboratories were represented at the ceremonies by R. K. Honaman, director of publication, and it is noteworthy that the inventor himself was present and spoke briefly after the unveiling of the plaque.

THE NIKE guided missile system *must* work when it is needed. Bell Laboratories has, therefore, provided a maintenance plan based on the extensive use of plug-in units which can be used by armed service personnel with limited training. Operating crews replace units suspected of malfunctioning with new ones, and send the suspect units to two trailer-mounted "electronic shops" which contain all the equipment necessary for servicing a number of NIKE installations. There, operators use a type of card file system to determine the correct test procedure for each plug-in unit. This card file tells the operator what consoles are to be used to test a particular unit, how to set up the unit for test, and what test indications to look for. A contact assembly in the form of a thin box is also provided for each type of test which is so wired that all the necessary switching is done automatically.

NEW METHODS, techniques and apparatus have been developed to provide for pressurizing exchange cable plant. To make this economically feasible, it was decided to supply dry air rather than nitrogen to exchange cables. A compressor-dehydrator system which is equally suitable for pressurizing toll and trunk cables was developed at Bell Laboratories to fulfill this need. Essentially, this apparatus consists of an air compressor, two drying towers filled with a desiccant, an electrically operated timer for switching the air supply from one tower to the other, and the valves, piping, and alarms necessary to ensure a continuous delivery of dry air under controlled pressure.

A HAPPY NEW YEAR to you, gentle readers!

A greeting no less sincere for being belated—at least according to the calendar. But there's bound to be a good deal of relativity in a quarterly publication; and an issue dated Winter necessarily spans Christmas and New Years and February's holidays, and carries good wishes, as cordially as the impersonality of type permits, for all of them.

This Winter issue is of particular interest to those who have been concerned with its preparation, because it is identified as VOL. XXXV No. 4—which means that it completes 35 years of publication.

Anniversaries of this sort are of real interest to relatively few—mostly those who live with the publication from year to year—but it would be unrealistic to expect any editor to forego entirely the opportunity for his book to toot its own tuba when the years have rolled around again to some more or less impressive accumulation denominated in multiples of five or ten.

Actually, thirty-five isn't very significant as an anniversary. Ten years ago our Twenty-Fifth Anniversary—note the capitals—was marked by the publication of a cumulative quarter-century index—which turned out to be a useful thing for people who want to look up something in the first twenty-five volumes of the MAGAZINE. And the Fiftieth Anniversary, in 1972? Who knows—maybe there will be a special service pin, or a gold medal for faithful readers still extant.

Meanwhile, our frontispiece observes this occasion by reproducing some of the physical changes which have marked the years since VOL. I No. 1—April 1922.

And yet physical changes are—or should be—only the conseqences of other and more important changes. We hope that each new format shown there accompanied some growth in service to the business: broader viewpoint, more interesting handling of subject-matter, even wider distribution to telephone people.

There has been real expansion in this last field. Ten years ago—in 1946—about 21,000 copies of each issue of the MAGAZINE were distributed, of which just about half went to non-Bell organizations and individuals. Five years ago, 20,000 copies were going regularly to Bell System readers, with still about the same 10,000 non-Bell distribution. The print order for this issue is above 50,000; and while the non-Bell distribution has increased a little, the distribution to those for whom the MAGAZINE is really published—Bell System people—is now up to nearly 40,000.

TO WHAT END? How useful or informative or stimulating is the book, after 35 years of editorial thought and effort—and sweat?

Occasionally a reader is kind enough to write in and say that he—or she—thinks well of the MAGAZINE, or was interested in a given article, or liked a cover or some particular illustration. That brings a warm glow in response, of course; but telephone people are no more communicative than others. and it isn't to be expected that they will run off at pen point just because they come across something they happen to like. After all, we all *have* to do an awful lot of reading.

A few months ago, however, something happened that seems definitely encouraging.

One of the Associated Companies which sends this MAGAZINE to all its supervisory people sent them also a questionnaire about how they like it—a typical thorough-going Bell System survey. A 42 per cent response gave a pretty good cross section. Better than nine out of ten said they liked the MAGAZINE "very much" or "fairly well," and wanted to continue to receive it regularly. On the average, readers spend more than half an hour with each issue, a third of them spend more than an hour, and one in four reads it all.

This—and more—out of a clear sky, makes it appear that the MAGAZINE is approximating with some success the job it undertakes to do.

What is that job? Well, it is expressed in essence at the mast-head of each issue. Remember?

ANOTHER WAY in which the MAGAZINE has changed—and developed, we trust—is in the matter of pictures, both on the cover and in textual illustration.

"A Sea Lion and Lioness." From Commodore George Anson's "A Voyage around the World in the Years 1740-1744." 15th Ed. London, 1776.

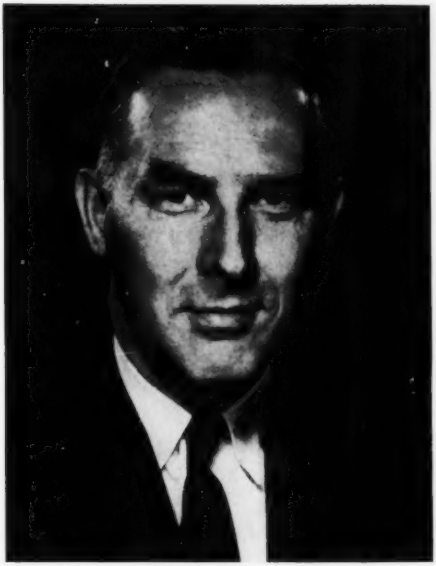
There had long been whispers—faint but insistent—that MAGAZINE covers should be "prettier." A series of cover etchings by some of the country's best-known practitioners of this specialized art, as a first move in that direction, failed to evoke any great enthusiasm —perhaps because they weren't very "warm." The paintings used on the covers since then have apparently been more welcome, and it is planned to continue them in one form or another. Incidentally, it is perhaps of some interest that, lively as they are, they are planned and executed in only two colors, in the interest of economical production.

The cover of this issue, further illustrating "The Sea Around Our Cables," was painted for us by Albert Pucci, a young New York painter and designer of illustrative art, who, like others in his field, has exhibited at and received awards and prizes from many art shows and whose work hangs in various galleries.

The illustrations in this issue happen to come from an unusually wide variety of sources. The files of commercial photographers are represented, as is seldom the case. The manufacturers of computing machines have loaned us photographs of their products, scientific organizations have allowed us to use their pictures and designs, and some of Mr. Nichols' own splendid color shots of land and sea and shore have been translated into black and white for reproduction. Some of the editor's modest collection of old maps and prints help to enliven that article, since it deals with far-flung places. Even the fabulous creatures on this page, identified as a sea lion and lioness but to him more familiarly known as Joe and Jessie, might once have frolicked on some shore which now knows—or will know —a long, thin, sea-serpentine monster carrying words they could never hear.

WELL—see you in VOL. XXXVI No. 1. J.S.B.

Philip J. Buch



H. I. Romnes

Who's Who & What's What

(Continued from page 187)

Mr. Elder joined Illinois Bell in 1925 as a student engineer, and his telephone career has been very largely devoted to matters related to outside plant engineering and construction. After six years as Area plant engineer in the Chicago Area, he transferred to the State Area engineering organization as outside plant engineer —the position he now holds.

Mr. Buch started in the Bell System with the Indiana Bell Telephone Company in 1930. There he held various line and staff assignments in the Plant Department until 1943, when he transferred to the outside plant section of A. T. & T.'s Department of Operation and Engineering. He became methods and materials engineer in 1950, and in 1953 was made cable engineer, his present post.

FOR SEVEN YEARS, from 1928 to 1935, H. I. ROMNES was a member of the technical staff of the Bell Telephone Laboratories, working on circuit design – and, incidentally, receiving six patents. In the next 15

Eldon Nichols

years, his responsibilities in the engineering division of the O. and E. Department included being head of the toll transmission group, radio engineer, and plant extension engineer. In 1950 Mr. Romnes served the Illinois Bell Telephone Company as building and equipment engineer and as chief engineer. He then became general manager at Long Lines and – through change of title – director of operations. Returning to O. and E. in 1952, he was successively assistant chief engineer and chief engineer and, since October of 1955, vice president–and head of that department. He contributed "The Messages Go Through in Many Ways" to this MAGAZINE for Autumn 1945.

WITH THE ALASKAN AND HAWAIIAN submarine telephone cables included in his present assignment, Eldon Nichols' "beat" covers a good many miles of ocean. He has found a new interest in what goes on beneath the surface, and he has helped greatly in obtaining illustrations which accompany his article. Joining the Long Lines Plant organization in Boston in 1922, he moved to New York in 1925, and continued with the Plant Department for the next 15 years as transmission supervisor, division service supervisor, division telegraph superintendent, and staff representative in the overseas staff group. From 1942 to 1945 Mr. Nichols was with the U. S. Army Signal Corps in Washington and in the South Atlantic and Central and Western Pacific areas. He returned–as an ex-Lt. Col.–to Long Lines as circuit layout engineer in 1946, became military plant engineer in 1951, and then engineer of equipment and buildings. His present appointment, as project manager of the Alaskan and Hawaiian cables, dates from January 1, 1956. His contribution "Command Circuits," a description of the multichannel radio teletypewriter circuits which were the backbone of Army communication with overseas theatres of war, was published in these pages for Summer 1946.

Reprints

(Continued from page 246)

sees a special need which reprints will meet, the order may be for but a few thousand.

There is a wide variety in uses also. Since the MAGAZINE itself goes mainly to supervisory telephone people, the Companies distribute a good many reprints to all employees in a given department or concerned with a certain operation. Occasionally an article appears in the MAGAZINE which somebody finds "stimulating" (alias "inspiring") and he orders copies for all the employees for whom he is responsible. Some of the Companies have success in selective distribution of reprints to civic leaders, local authorities, and various individuals to whom certain information might be interesting or valuable. Ingenuity finds no limit to the ways in which the usefulness of this MAGAZINE can be thus extended.

BELL TELEPHONE MAGAZINE

VOLUME XXXV, 1956

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